LIST OF PLATES.

Note.—Plates 5, 6, 7, 8, and 12 have not been included in this edition, but four new plates have been added.

MANUAL

OF

MAP READING

AND

FIELD SKETCHING.

PART I.

CHAPTER I.

INTRODUCTION.

1. This manual is intended for the use of candidates for com-

sketches for military purposes.

All regimental officers must be so trained as to be proficient in the following subjects:—

to an existing map or to an enlargement.

iv. A certain amount of sketching on blank paper.

Selected officers, who show special aptitude in iv, should receive further instruction in sketching on blank paper (*see* Part II).

LIST OF PLATES.

Note.—Plates 5, 6, 7, 8, and 12 have not been included in this edition, but four new plates have been added.

2. A military map or field sketch should show all the features of, or in, a country, natural and artificial, which are of importance from a military point of view, *i.e*, those which might affect the dispositions, movements, security, or supply of troops A military *map* is the work of a trained *surveyor*, using special instruments and elaborate methods, with unlimited time at his disposal, and aiming at minute accuracy. A field *sketch* is a sketch of ground made with such instruments and under such conditions regarding time, weather, etc, as generally exist in the field.

3. Military *maps* may be conveniently classified into strategical maps on very small scales, small scale maps, and large scale maps

Strategical maps are used for conducting the operations of an army as a whole. Examples of this class are the $\frac{1}{1000000}$ (about 16 miles to 1 inch) and the 6 mile to 1 inch map of Belgium and N E. France

Small-scale maps, such as maps on the scale of 1 inch, ½ inch, or ¼ inch to the mile (or similar scales) are required to assist troops to manœuvre and fight Of these, maps on the scale of 1 inch to the mile will usually only be available for the use of the higher commanders and their staffs. Subordinate commanders and regimental officers will normally be supplied with maps on the scale of ½ inch or ¼ inch to the mile

Large scale maps (2 inches to 1 mile and upwards) are not always available in war When available they would only be issued to certain units in small quantities. They are especially useful, when squared, to heavy artillery working in co-operation with aeroplanes.

4. Field *sketches*, which are usually made on a scale of from 1 to 4 inches to 1 mile, are of two kinds. They may be occasionally required to illustrate in detail the disposition of troops, to indicate lines of advance in attack, or to represent minor features of ground of tactical importance when maps are not [illegible] ould be as accurate as [illegible] the minute accuracy [illegible] duction of his map is [illegible] These sketches are executed by officers who have received special instruction, and are usually carried out with special instruments, such as the plane table

Rough field sketches are also required in the circumstances described in para 1 iv above Every regimental officer, and

i. *Map reading*

An officer, or non-commissioned officer, may be said to be proficient in map reading when on examination a map conveys to him a clear impression of the ground features as represented by contours or shading, and of all the natural or artificial features exhibited on the map. Further, he should be able to identify his position on the ground quickly and to recognize all visible objects marked on the map

This requires close study and constant practice, and is an important branch of military education

ii *Map enlarging*

This should be executed by the methods described in Chapter VI, usually the scale of the enlargement will not exceed 4 inches to 1 mile.

iii *Adding topographical information to a map.*

This comprises one of the most probable and most important duties in sketching that an officer may be detailed to carry out in the field. Troops will rarely now be operating in an entirely unmapped country, but the existing maps will often fail to give the military information which is essential to the conduct of operations. Officers may therefore be employed on service, on work of this nature.

iv. *Sketching on blank paper.*

It will occur, though possibly rarely, that no map exists of a locality. It is therefore necessary that officers should be able to make a sketch. Such a sketch is not intended to be an accurate survey, but must include all information which is likely to affect the military object in view.

It should also be remembered that a rough sketch to an approximate scale is a valuable addition to a written report on a locality, and should be executed whenever time permits, if it is not possible to enlarge an existing map and add such information as is necessay to the enlargement.

2. A military map or field sketch should show all the features of, or in, a country, natural and artificial, which are of importance from a military point of view, *i.e.*, those which might affect the dispositions, movements, security, or supply of troops. A military *map* is the work of a trained *surveyor*, using special instruments and elaborate methods, with unlimited time at his disposal, and aiming at minute accuracy. A field *sketch* is a sketch of ground made with such instruments and under such conditions regarding time, weather, etc., as generally exist in the field.

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Small-scale maps, such as maps on the scale of 1 inch, $\frac{1}{2}$ inch, or $\frac{1}{4}$ inch to the mile (or similar scales) are required to assist troops to manœuvre and fight. Of these, maps on the scale of 1 inch to the mile will usually only be available for the use of the higher

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4. Field *sketches*, which are usually made on a scale of from 1 to 4 inches to 1 mile, are of two kinds. They may be occasionally required to illustrate in detail the disposition of troops, to indicate lines of advance in attack, or to represent minor features of ground of tactical importance when maps are not available for enlargement. Such sketches should be as accurate as time and the means available will permit, but the minute accuracy which is required by the surveyor in the production of his map is not expected and should not be attempted. These sketches are executed by officers who have received special instruction, and are usually carried out with special instruments, such as the plane table.

Rough field sketches are also required in the circumstances described in para. 1 iv above. Every regimental officer, and

a proportion of non-commissioned officers, should be able to make such sketches with such instruments as they are likely to have on service. These instruments are:—

i. The service compass.
ii. The service protractor
iii. The cavalry sketching board, or some improvised form of sketching board.

5. This manual is therefore divided into two parts

Part I.—The elementary instruction, embracing map reading and such field sketching as is likely to be required of regimental officers and non-commissioned officers on active service

Part II.—Further instructions in field sketching for officers who may be employed on special duty.

CHAPTER II.

Definitions.

6. *Topographical forms*

Basin: A term used to describe (*a*) a small area of level ground surrounded or nearly surrounded by hills; and (*b*) a district drained by a river and its tributaries, as the "basin of the Thames."

[illegible]

[illegible] at which a gentle slope changes to an abrupt one; the top of a bluff or cliff.

Escarpment: An extended line of cliffs or bluffs.

Gorge: A rugged and deep ravine.

Knoll: A low detached hill.

Plateau: An elevated plain.

Re-entrant: A valley or depression running into a main feature.

Saddle: A col.

Spur: A projection from the side of a hill or mountain running out from the main feature.

Underfeature: A minor feature, an offshoot of a main feature.

Watercourse: The line defining the lowest part of a valley, whether occupied by a stream or not.

Watershed: A ridge of high land separating two drainage basins; the summit of land from which water divides or flows in two directions. A watershed does not necessarily include the *highest points* of a chain of mountains or range of hills.

This list does not profess to be exhaustive; there are many terms in common use such as hill, mountain, river, slope, island, pass, cliff, &c., which it does not appear necessary to define.

7. *Technical terms.*

Angle: Back-angle, the direction or bearing in a traverse of a station which has been passed.

Closing-angle, the bearing taken from the last station in a traverse to some fixed point, to ascertain whether the traverse closes satisfactorily.

Forward-angle, the forward direction or bearing from one station in a traverse to the next in succession.

Base, or Base-line: A carefully chosen and accurately measured line upon which a triangulation depends.

Bearing: True bearing is the angle a line makes with the true north line.

Magnetic bearing is the angle a line makes with the magnetic north line.

In each case the angle is measured from North by East and South, *i.e.*, in the same direction as the hands of a watch move.

Ray: A line drawn to represent the direction of an object without reference to the points of the compass

Contour: The representation of an imaginary line running along the surface of the ground at the same height above mean-sea-level throughout its length Contours may also be defined as the plans of the lines at which a water surface (of the ocean, for instance) would intersect the surface of the earth were it raised successively by equal amounts

Datum, or Datum-level: An assumed level to which altitudes are referred.

Fall of a river · Its slope, usually measured in inches (or feet) per mile, thus 9 inches per mile.

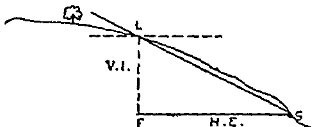
Form-line: An approximate contour; a sketch contour.

Gradient: A slope expressed by a fraction. Thus $\frac{1}{20}$ represents a rise or fall of 1 foot in 20 feet.

Hachures: Vertical hachuring is a conventional method of representing hill features by shading in short disconnected lines drawn directly down the slopes in the direction of the flow of water on the slopes (*See* Plates 5, 10, and 11.)

Horizontal Equivalent: Sometimes written H.E., is the distance in plan between two adjacent contours measured in yards. In Fig. 1, if S.L. is a slope, H.E. is the horizontal equivalent for that particular slope and vertical interval (*see* definition below).

Fig. 1



Local Magnetic Attraction: The deviation of the magnetic needle of a compass from its mean position owing to the presence [illegible]

[illegible] and [illegible] year. [illegible] is E.

Orienting or **Setting** a map or plane-table is the process of placing the map or plane-table so that the north line points north.

Plotting: The process of laying down on paper field observations and measurements.

Resection: A method by which the sketcher determines his position by observing the bearings of, or drawing lines from, at least two previously fixed points.

Section: The outline of the intersection of the surface of the ground by a vertical plane.

Spot Level: The record on a map of the exact height of a particular point.

Traverse: The survey of a road, river, or track by measuring a continuous series of straight lines along its course and the angles at their junctions.

Triangulation: The process of fixing the position of points on the area to be surveyed, by means of a measured base and a network of triangles dependent on it.

Vertical Interval: Sometimes written V.I., and always given in feet, is the difference of level between two adjacent contours.

L.F. in Fig. 1 is the vertical interval between contours at L. and S.

CHAPTER III.

Scales.

8. The word **scale** is used to denote the proportion which a distance between any two points on a sketch or map bears to the horizontal distance between the same two points on the ground. Thus, if the distance between two farms on a map be 1 inch, and the horizontal distance on the ground be 2 miles, the scale of the map will be 1 inch to 2 miles. Similarly the statement that a map is on a scale of $\frac{1}{250000}$ implies that a distance of 1 inch on the map represents an actual distance of 250,000 inches, or 3·95 miles.

(1) Scales on maps of the United Kingdom, India, and Canada are usually expressed in words showing the relation between inches on the map and miles on the ground, thus 1 inch to 1 mile, ½ inch to 1 mile, &c.

(2) Foreign maps and maps of British African Colonies and possessions are constructed on scales which bear the proportion of 1 to some multiple of 10, such as 1 to 250,000 or 1 to 1,000,000.

The scale adopted for the military map of South Africa is 1 to 250,000.

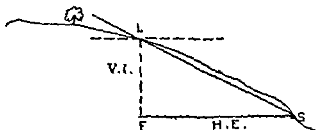
Form-line: An approximate contour; a sketch contour.

Gradient: A slope expressed by a fraction. Thus $\frac{1}{30}$ represents a rise or fall of 1 foot in 30 feet.

Hachures: Vertical hachuring is a conventional method of representing hill features by shading in short disconnected lines drawn directly down the slopes in the direction of the flow of water on the slopes (*See* Plates 5, 10, and 11.)

Horizontal Equivalent: Sometimes written H.E., is the distance in plan between two adjacent contours measured in yards. In Fig. I, if S.L is a slope, H.E is the horizontal equivalent for that particular slope and vertical interval (*see* definition below).

FIG. 1.



Local Magnetic Attraction: The deviation of the magnetic needle of a compass from its mean position owing to the presence of masses of magnetic iron ore or of iron in the neighbourhood.

Meridian or **Meridian-line:** A true north and south line.

Magnetic Meridian: A magnetic north and south line.

Magnetic Variation: The angle between the true north and the magnetic north. This angle varies slightly from year to year. It is called E. or W. variation, according as the magnetic N. is E. or W. of the true N.

Orienting or **Setting** a map or plane-table is the process of placing the map or plane-table so that the north line points north.

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(2) Foreign maps and maps of British African Colonies and possessions are constructed on scales which bear the proportion 1 to some multiple of 10, such as 1 to 250,000 or 1 to 1,000,000.
The scale adopted for the military map of South Africa 250,000.

The following examples are explanatory of the two methods of expressing scales —

(i) Scale $\frac{1}{63360}$, or 1 inch to 1 mile

(ii) 1 : 100,000 (or $\frac{1}{100000}$), or (on a Foreign map) 1 centimetre to 1 kilometre.

The fraction in each case is called the **Representative Fraction** or **R.F.,** and means that 1 unit on the map (numerator) represents a certain number of the same units on the ground (denominator), thus from i above—

1 inch on the map represents 63,360 inches on the ground (= 1 mile),

from ii

1 inch on the map represents 100,000 inches on the ground (= 1·58 miles), or 1 centimetre on the map represents 100,000 centimetres (= 1 kilometre) on the ground

The advantage of (i) is that the eye, having once been trained to recognise the length of an inch on paper, can readily estimate the distance between any two points on a map with considerable accuracy

To find the number of English miles to the inch for any map that has a R F, divide the denominator of the R F by 63,360, this gives the number required thus if R F is $\frac{1}{80000}$, then the number of miles to the inch = $\frac{80000}{63360}$ = 1·26

To find the number of inches to the mile, divide 63,360 by the denominator of the R.F., thus, if R F. is $\frac{1}{80000}$, then the number of inches to the mile = $\frac{63360}{80000}$ = ·79

9. The measure of length which a scale is to show, whether feet, yards or miles, is termed the *unit of measure*, and scales are usually, though not necessarily, constructed of such a length as to represent a distance which is a multiple of ten such units, as 100 feet, 50 yards, 80 miles

A scale should usually be from 4 to 6 inches long, and to construct it the number of tens, hundreds, or thousands of the "unit of measure," which will occupy such a length on paper, should be calculated.

10 The size of the scale generally used for field sketches depends [illegible] naissance sketches of an area of ground to explain a plan of attack, or to show lines of advance, of a road or river, or of a defensive or

outpost position, are usually made on scales ranging from 1 to 4 inches to 1 mile. Sketches which may be required for the defence of a village or town, or for the selection of a camp or billeting area, are generally made on the scale of 4 inches to 1 mile.

11. The service protractor (*see* Plate 14) shows scales of $\frac{1}{2}$ inch, 1 inch, 2 inches and $2\frac{1}{2}$ inches to 1 mile, also scales of miles for R F's. of $\frac{1}{50000}$, $\frac{1}{100000}$ and $\frac{1}{250000}$, and a scale of kilometres for $\frac{1}{100000}$ (1 centimetre = 1 kilometre) Thus the normal scales of English and foreign maps can be drawn from the protractor.

Example.—To draw a scale of 4 inches to 1 mile to show divisions of 100 yards from the protractor. Here the most convenient scale shown on the protractor is that of 2 inches to 1 mile. The distances shown on this scale are twice those on the scale to be drawn. The scale is to be between 4 and 6 inches in length. On measuring off 4 inches from the scale of inches on the back of the protractor and applying this distance to the 2 inches to 1 mile scale, it is found that 4,000 yards is the nearest convenient round number, which gives a length of more than four inches. Draw a line equal in length to 4,000 yards on the 2 inches to 1 mile scale, this line represents 2,000 yards on the scale of 4 miles to 1 inch Divide this line into 4 equal parts, each representin

from it.

Primaries should be chosen so as to show miles or kilometres in units, tens or hundreds, or yards, in thousands or five hundreds, according to the unit of measure shown and the size of the scale. Thus a scale of miles or kilometres should show primaries of miles or kilometres; a scale of yards or metres should show primaries of thousands of yards or metres for scales up to $\frac{1}{31680}$, and five hundreds of yards or metres for larger scales. Secondaries should show $\frac{1}{4}$ miles, twentieths of kilometres, or hundreds of yards. Military *sketches* can rarely be of sufficient accuracy to make it necessary to show smaller secondaries, these are however shown on the protractor, which may be used to measure distances on military *maps*.

Then 5,000 yards will be represented by $\frac{5,000 \times 36}{31,680}$ inches,
or 5·68 inches.

Draw a line 5·68 inches long.

Divide this into five equal parts (each being therefore 1·14 inch long).

Subdivide the left division into 10 equal parts, each 0·11 inch long; each of these will represent one hundred yards. (Plate 1.)

Ex. 3—To construct a scale of 1 inch to 1 mile to show miles and quarters of a mile.

Here it is clear that all that has to be done is to take a length of say 6 inches representing 6 miles, divide this into inches and the left division into quarters.

Ex. 4.—To construct a scale of $\frac{1}{100,000}$ to show miles.

Here 1 mile is represented by $\frac{1}{100,000}$ mile.

$$i.e., \text{ by } \frac{63,360}{100,000} \text{ inch} = 0·634 \text{ inch.}$$

[illegible]

Ex. 5—To construct a scale of time for a column of troops marching at the rate of 3 miles an hour.

As an example, the scale of the map may be taken as 1 inch to 2 miles, which gives

$$\text{R F.} = \frac{1}{63,360 \times 2} = \frac{1}{126,720}$$

If the scale be made 6 inches long, it will represent 12 miles, *i e*, [illegible] nd each [illegible] ion into

Ex. 6.—To construct a scale of miles for a foreign map on which no R.F. is given.

(1) Suppose the map has a scale of versts (1 verst = 42,000 inches) shown. Measure the length in inches of any number of versts, and say that 10 versts are found to measure 1 inch, then the

$$\text{R F} = \frac{1}{\text{No of inches in 10 versts}} = \frac{1}{420,000}$$

40 miles will be represented by $\frac{40 \times 1,760 \times 36}{420,000} = 6 \cdot 03$ inches.

Draw a line 6·03 inches long and divide into 4 parts, each will represent 10 miles, divide the left quarter into 10 to show single miles.

In the heading of the scale, after the R F, the number of miles to the inch should be stated. In this case 1 inch represents 420,000 inches Therefore, the number of miles to the inch (*see* para. 8)

$$= \frac{420,000}{63,360} = 6 \cdot 63$$

(2) If neither the R F nor the scale be given, the distance on the ground between any two points shown on the map must be ascertained, either by *reference to another map* with a *scale marked* on it, or by actual measurement on the ground

Suppose in this case that the distance between two villages measures, on the map, 1·5 inch, and the actual distance between them is ascertained to be 3,000 yards,

$$\text{then R F} = \frac{1 \cdot 5}{3,000 \times 36} = \frac{1}{72,000}$$

Since this is a smaller fraction than the R F. ($\frac{1}{63360}$) of 1 inch to the mile, *the scale of the map is rather less than 1 inch to the mile* If, therefore, we take 6 miles, we shall obtain a scale of suitable length.

6 miles will be represented by $\frac{6 \times 1,760 \times 36}{72,000} = 5 \cdot 28$ inches.

Draw a line 5·28 inches long and divide it into 6 parts, each of which will represent a mile.

The left division may be subdivided to show quarters of a mile.

CHAPTER IV.

Conventional Signs and Lettering.

Conventional signs.

13. Conventional signs enable the draughtsman to give an amount of information on a sketch, or map, which could not, conveniently, be otherwise conveyed. They should be simple in character, so that they may be easily understood, and not numerous. It is better to write descriptions on the face of a sketch, or in the
it referred to, in
it with symbols

Plate 2 shows the conventional signs approved for field sketches. These signs should be studied, and used in making a field sketch. In cases of great haste, however, it is sometimes more convenient to describe the object than to draw its symbol.

The conventional signs used on Ordnance Survey maps differ slightly from those used in field sketching, the latter being modified in some cases so that they may be simpler to draw. The conventional signs used on the 2 miles = 1 inch Ordnance Survey are shown on Plate 3

A **Road** is drawn with continuous lines when it is enclosed by a fence, ditch, or obstacle of any kind, and with dotted lines when unenclosed.

It should be noted whether a road is metalled or unmetalled, and occasionally it is desirable to give its width. Thus 14′ m. would mean a road the metalled portion of which is 14 feet wide. 14 feet of metalling will allow of two lines of traffic in opposite directions; less than 14 feet will not. Metalled roads suitabl for traffic at all times should be coloured brown; those like

be cut up in bad weather dotted brown If no colour is availa the word "metalled," or "unmetalled," and any additional inforr tion required should be inserted.

A **Railway** is shown by a continuous, thick, black line w cross-bars; the word "single," or "double," should be written alc it as the case may be

Opposite the point where a main road or railway is stopped the margin the name of the nearest important town or village shou be written and also its distance from that point in miles, *Thu Canterbury* $3\frac{1}{4}$ *miles*.

Form Lines and **Heights** are drawn in brown or r Form lines should be shown by almost continuous lines, brok occasionally by very short spaces and dots where the hand requi a rest.

Cultivation is denoted by inserting in writing the nature the crops. If they present any obstacle to the advance of troo or afford cover, a note to that effect should be added; but su information should only be given if required by the object of t sketch.

A **River** is drawn in blue, with its name written along its cour and the direction of its current indicated by an arrow. T width of the river, and any further information as to the botto and banks required to show its nature as an obstacle should noted on the sketch. The bed of a river or stream which is d at the time of sketching should be shown in black, a note as its liability to flood being made on the sketch.

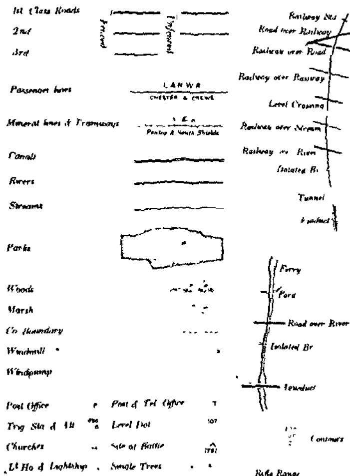
The nature of a **Bridge** is indicated by the word *iron*, *sto wood*, *suspension*, *&c*. The principal dimensions of important bridg and their suitability for heavy traffic should be stated.

Heath, Heather, or **Marsh** is shown by writing the wo *heath*, *heather*, or *marsh* in black. When finishing up the sketch t conventional sign shown on the plate may be ad[illegible] permits.

[illegible] **W**[illegible] whether th [illegible]

stated.

CONVENTIONAL SIGNS FOR THE HALF-INCH TO ONE MILE MAP OF GREAT BRITAIN



On the older editions the Woods are shown in Green

The letters P and T indicating Post and Telegraph Offices are not written in those towns which would obviously have a Post or Telegraph Office

Ordnance Survey Office, Southampton

The conventional *colours* are shown on Plate 2. For rough sketches, coloured chalk pencils may be used.

Troops.—It may be necessary to show the disposition of troops on a sketch, as, for instance, when making proposals for the distribution and action of a given force It is not desirable to spend time in drawing troops in any form to scale. It is sufficient to draw a symbol which will attract the attention, writing the necessary information as regards strength and unit alongside or in the margin

In outpost sketches, the letters P, S, R, may be written instead of piquet, support, and reserve.

The direction of a *patrol* is shown by an arrow.

Lettering.

14. Whatever lettering appears on a sketch must be easily legible, should not interfere with the detail, and should show clearly to what it refers. These are the only essential conditions.

It is within the power of all officers to adopt and use some simple style of lettering which shall be clear, and quickly written. Each letter should be separate.

The principal words, *i e*, names of towns, villages, and rivers should be in simple block letters (*See* Plate 2.)

All lettering should be horizontal, excepting the names and directions of rivers, railways, roads, and canals, which should be written along them; words descriptive of the nature and condition of a tract of country should be written so as to, as far as possible, extend over the portion of ground described.

CHAPTER V

British and Foreign Maps, and Methods of Representing Hill Features.

15. The chief difficulty felt by most students in reading maps is in understanding the methods used to represent hill features. These consist of various artifices by means of which the inequalities of the ground are shown.

The following systems are employed for showing hill features on maps:—

1. Contours, or approximate contours, *i.e*, form lines.
2. Contours and hachuring, *i e*, shading
3. Hachuring alone
4. Layer system (altitude tints).

Plates 7, 8 and 9, show maps in which hill features are represented by contours.

Plate 5 shows maps representing hill features by contours and hachuring combined.

Plates 10 and 11 show hachuring alone.

Plates 6 and 12 show maps in which the hill features are represented by the layer system.

16. Contours.—These are best explained by the following simple practical illustrations —

All students will be familiar with the ordinary wooden or plaster models sometimes used to represent in relief hills and other geographical features.

Say we have such a model, the scale of which we know to be $\frac{1}{12}$, *i e.*, one inch on the model represents one foot on the ground.

We place the model in an empty tank or bath, and pour in water until there is one inch of water in the bath.

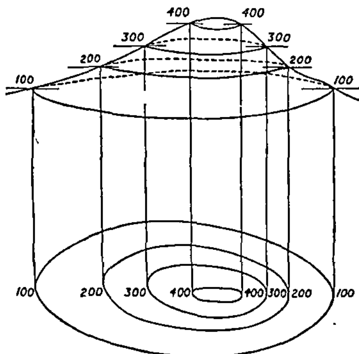
The watermark will cut the model one inch vertically above its base, all round We draw in this watermark with an indelible pencil.

We now add water until there are two inches in the bath, and the new watermark is drawn in.

We continue to add water by inches in this way, and to draw in the successive watermarks, until the model is completely covered with water.

Fig 2

View of a hill with contours supposed to be visibly marked.



Plan of the same hill.

On removing the model we find it marked with a succession of lines, which we know are vertically one inch above the other. These lines are "Contours."

Now if we make a drawing of the model as seen from above, *i e.*, a "plan" of the model to the actual scale, we shall have marked on it "Contours" at one inch vertical interval—or in other words, we have a map of the actual ground, on the scale of $\frac{1}{12}$, with "Contours" at *one foot* vertical interval

In practice, for ordinary scales, "Contours" at so close an interval as one foot would be too numerous. The interval between the "Contours" depends generally on the scale. Fig 2 gives the views of a hill with "Contours" 100′ apart.

17. Contours have certain advantages for the map reader over other artifices, viz .—

i. They show the hill forms with exactness, and not vaguely, as is the case with shading.
ii. They require little artistic talent to draw.
iii. They obscure the detail less
iv. They can be reproduced by lithography in the field.

They present, however, a disadvantage to the map maker, in that the methods required to produce them involve great labour and consequently expense This explains why only the best maps are contoured, and then only at considerable interval of height. In view of these advantages and disadvantages as regards contours, a kind of compromise is adopted for Field Sketching, and the method of showing hill features to be used is that of **form-lines** which are approximate to contours sketched in by eye.

18. Certain points should be noticed by the student as regards the information conveyed by contours or form-lines. Thus :—

i. If a map shows contours close together, the slope there will be steeper than in places where the contours appear further apart. In Fig. 3, plan, the ground is steeper at A B than at C D. This is at once apparent if sections be drawn as follows :—

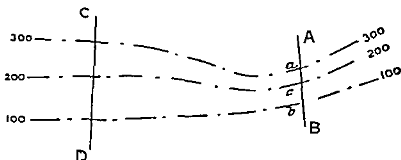
Draw equidistant and parallel dotted lines equal in

300 to correspond to the remaining contours. Mark a dot b on the lowest dotted line to represent the point where the section line A B cuts the 100 contour in plan. From b, measure off $b\ c_{,} = b\ c$ in the plan. At $c_{,}$ draw $c_{,}c$ perpendicular to the 100 dotted line, so as to cut the 200 dotted line at c Then measure $b\ a_{,} = b\ a$ in the plan, and draw $a_{,}\ a$ similarly to cut the 300 dotted line at a Draw the line A a c b B in the section. The line C D is similarly drawn, and the slopes A B and C D can be compared.

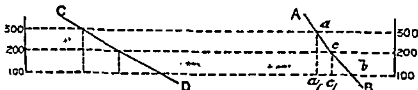
Section drawing of this nature is purely for instructional purposes and has no practical value

FIG. 3.

PLAN



SECTION



ii. When contours bend they portray a spur or projection; or they portray a valley or re entrant. To ascertain

which, the numbering of successive contours must be examined if there is no distinctive shading in addition to contours.

In Fig. 4, reading the contours down from 300 feet to 100 feet, and imagining them raised on uprights to scale corresponding to these heights, the bend A B is seen at once to be a spur, the bend C D a valley.

iii. Referring to Plate 4, slopes may be **uniform**, like A B, **convex**, like C D, or **concave**, like E F.

Now, if contours be drawn in plan to represent a short distance of these slopes, it will be apparent that their spacing in each case is distinctive of the particular kind of slope represented, as follows —

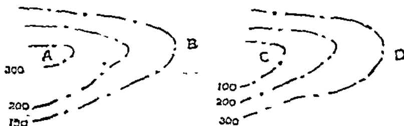
i. When the contours are evenly spaced as in plan (1) the slope represented is uniform.

ii When the spacing, reading from high to low, decreases, as in plan (2), the slope is convex

iii. When the spacing, reading from high to low, increases, as in plan (3), the slope is concave.

It may be noticed that uniform and concave slopes, (1) and (3),

Fig 4

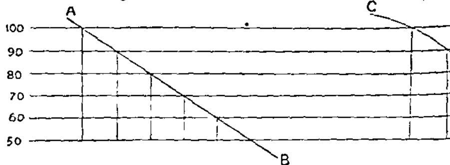


afford no dead ground Convex slopes (2), on the other hand, do afford dead ground.

19. Slopes may be expressed either in degrees or as a gradient.

Slopes are usually expressed in military terms as a gradient, *i e*, by a fraction—Thus $\frac{1}{30}$ represents a rise or fall of 1 foot in 30 feet.

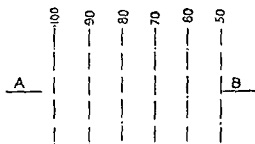
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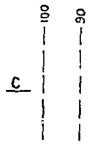


P

(1) *Uniform.*

(2) Co

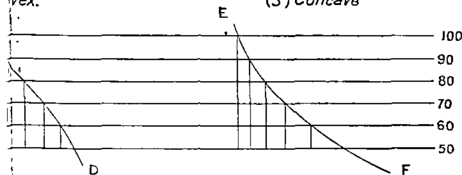




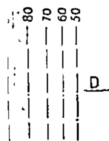
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PLATE 4.
To face page 24

ɪONS.



ᴾLANS





[illegible] a slope given in [illegible] hus a slope of 3° [illegible]. This rule does not hold for steep slopes.

20. The following slopes are generally practicable for wheeled vehicles, but much depends upon the surface of the ground.

For short distances the slope may be $\frac{1}{7}$ for artillery.

" " " " " " " $\frac{1}{15}$ for transport animals.

Steeper than $\frac{1}{10}$ is inconvenient for animals or wheeled traffic

Traction engines can draw their own weight up $\frac{1}{10}$, twice their weight up $\frac{1}{20}$, three times their weight on the level or up slopes not exceeding $\frac{1}{33}$. (For the method of measuring slopes, *see* para. **54.**)

21. The student should exercise himself in studying the system of contours as a means of depicting hill features. He should imagine some type of ground with various combinations of spur, valley, and slope, and then endeavour to portray these by contours. Conversely, he should draw contours with various curves and spacing, number these successively, and work out the ground they represent Such preliminary exercises will greatly assist him to read hill features on contoured maps fully, rapidly, and with accuracy.

CHAPTER VI.

Copying and Enlarging Maps.

22. Copying.—Maps which are to be simply copied without reduction or enlargement, may be first traced on tracing paper, and then, a piece of carbon paper being placed between the tracing and a clean sheet of paper and both very firmly fastened down by drawing pins, the tracing may be transferred by following the lines with a pointed instrument.

carbon paper can be made of tracing paper, in fact, Any sharp piece of wood will do for the tracing instrument.

A map may also be transferred direct without a tracing; but there is some danger of damaging the original with the point.

Tracing cloth is useful for copying it is tough and will bear much handling Draw on the glazed side, and put washes of water colour, if required, on the back, darker than they are intended to appear on the front

23. Enlarging.—When it is required to enlarge a map, squares of any convenient size may be drawn on the original, and the paper on which the new map is to be made ruled with squares whose sides bear the required ratio to the sides of the squares on the original. The original is then copied by eye, so that objects occupy the same positions relatively to the squares as they did in the original (*See* Fig. 5.)

Ex. 1.—It is required to enlarge to 4 inches to 1 mile a map of which the scale is $\frac{1}{2}$ inch to 1 mile. Squares, $\frac{1}{4}$ inch sides, are drawn on the map Then to find the length of sides of squares on the enlargement, we have :—

$$\tfrac{1}{2} : 4 : \tfrac{1}{4} : \text{Length required.}$$

Whence sides of squares required = 2 inches.

Ex. 2—A plan with R.F. $\frac{1}{100000}$ is to be copied at 4 inches to a mile. Squares, $\frac{1}{4}$ inch sides, are drawn on the plan. The R.F. of 4 inches to 1 mile being $\frac{1}{15840}$, the length of sides of squares on the copy is obtained by proportion, thus :—

$$\tfrac{1}{100000} : \tfrac{1}{15840} : \tfrac{1}{4} . \text{Length required}$$

Whence required side of square = 1·58 inches.

Army Book 153 and most service pocket books contain paper ruled in quarter-inch squares. When such paper is available, it is usually only necessary to rule squares on the map which is to be enlarged.

Fig. 5 (i).



Portion of 1/2" Map of England

Fig. 5 (ii)

Hawkesbury

Longford

Enlargement 4 inches to 1 mile.

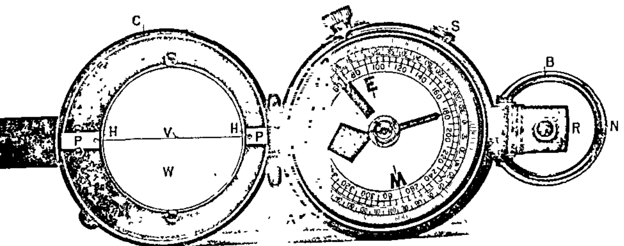
fifth degree and the points of the compass (*see* Plate 13) The metal cover, C, opens on a hinge, and is fitted with a glazed window, W, on which is traced a fine black hair line, V, for use as a sighting-vane. Opposite the hinge of the cover is fitted a prism, R, through which can be read the graduated edge of the dial, while at the same time an alignment of the object and of the sight-vane on the cover is observed through the slit above it The prism should be moved up or down in its slot till the figures on the dial are properly focussed A clamping-screw, S, is provided for clamping the needle when not in use, and a "check spring" A, for checking its oscillations when observing A brass ring, B, is attached for convenience in holding it.

The dial is "luminous" for night work, the north point is marked with a large diamond-shaped figure A revolving glass is fitted over the compass dial, and on the glass is a black direction mark, radiating from the centre, at the end of which is a small brass "setting vane," the latter working over an external arc graduated to 360° A brass screw, J, is used to clamp the glass. On the inside of the cover are two luminous patches, PP, which give a good alignment of the instrument at night when it is held in the hand with the cover wide open There are two small holes, HH, in the brass window-edge of the cover, so that, if the glass breaks, a horse-hair can be run between them, and an extemporized sight-vane be utilized.

The compass dial is graduated with two sets of figures which read eastward of the meridian (*see* definition, Chapter II), or from left to right, like the hands of a watch The outer set is for use with the prism, and commences at south in order that the bearing of the object may appear under the eye. Thus the vane being directed on an object which is 50° from north, it is that number measured from south which appears under the prism; or, in other words, 180° is over the north end and 360° over the south end of the needle. The inner set of figures is of use for direct readings (*i e.*, without the prism) as for compass marching, or when the instrument is used with the plane-table.

The prismatic compass gives "bearings" and not "angles" (*see* definitions, Chapter II). The horizontal angles between any distant objects are obtained by taking the difference of their observed bearings.

Example.—The angle between two points, A and B, is required. Their bearings are observed to be respectively 50° and 110°. The angle required = 110° − 50° = 60°.



PRISMATIC COMPASS

27. (*a*) *To use the compass as a hand compass.*

Hold the compass level in the hand, or place it on a level surface; when the card comes to rest.

The check spring can be used to steady the swing of the card so that it may more rapidly come to rest

The graduation of the *inner* ring of figures, immediately under the index line, *gives the magnetic bearing.*

(*b*) *As a prismatic compass.*

In order to obtain the bearing of a distant point, the observer directs the sighting vane of the compass on the object and reads its magnetic bearing in the prism

(*c*). *As a night marching compass.*

28. Marching on a Compass Bearing.—*To use a compass* with advantage on a dark night, it is essential that it should be prepared with "luminous paint" This substance must be kept *exposed to the light before using it, or it will be found to be* non-luminous when required. As a general rule, a compass exposed for half an hour before sunset will be sufficiently luminous to work by for some 6 to 9 hours afterwards.

In the *Service prismatic compass* the magnetic north is marked by a broad black arrow-head. The compass is so constructed that upon the black direction mark being turned to point to the required "bearing," as shown on the external ring, and the arrow-head [illegible]

pected from luminous paint is for a compass prepared with it to show a faint luminosity of the dial, just sufficient to throw up in relief the black direction mark and arrow-head.

[illegible]

marked north point.

31. *The Service Protractor* (Plate 14).

The service protractor for sketching is made of boxwood exactly 6 inches in length and 2 inches in breadth, it is divided on both sides as shown on Plate 14.

On it four scales of yards are shown —

$2\frac{1}{2}$ inches to one mile.
2 " " " "
1 " " " "
$\frac{1}{2}$ " " " "

on these scales the primary divisions show hundreds of yards.

Three scales of miles are shown —

$\frac{1}{80,000}$ or 1 inch to 1·26 miles.
$\frac{1}{100,000}$ " " " " 1·58 "
$\frac{1}{250,000}$ " " " " 3·94 "

One scale of kilometres $\frac{1}{100,000}$ is also shown.

The edge graduated in degrees is for reading and plotting angles, the arrow point showing the centre from which the angles are drawn.

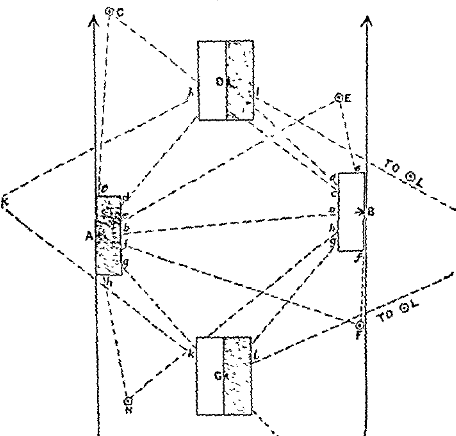
32. *Plotting and reading angles.*

The direction of an object observed with the compass, expressed in degrees from the magnetic north measured round up to 360° with the hands of a watch, is the bearing of the object, and can be laid down or plotted on a map or sketch with a protractor from the point of observation

In plotting angles, if these angles are magnetic bearings, and if it is required to plot any
line must be drawn throu
In practice it is not neces
this meridian through eve
is taken. Starting from so
is first drawn, and then a

latter serve as a general guide for placing his protractor on any point afterwards in the correct position. One of them will be near enough to the point to guide the eye.

FIG 7



NOTE—In above figure the protractor is unshaded when in position for plotting bearings between 180° and 360°.

It is usual to draw these parallel lines representing magnetic meridians about the width of the protractor apart. The protractor

can always be set with its long edge parallel to these lines, by making one of the lines cut each of the shorter edges at opposite and similar divisions, or by eye.

One end of these meridians should be marked with an arrow-head, to avoid the possibility of protracting the bearings in the reverse direction.

The protractor is laid on the map or sketch with the arrow at the point whence the bearing is to be drawn, and with its long edges set north and south, i e, parallel to the lines.

If the bearing is under 180°, the graduated edge of the protractor is laid to the right or east, if over 180°, to the left or west, the north margin of the sketch being uppermost.

The bearings of the various points in Fig 7 are read thus —

At A	At B	At G / At D / At F
C, 3°	F, 181°	At G: K, 309°
D, 40° 15'	G, 220° 15'	At G: L, 66° 15'
E, 60°	H, 232°	
B, 85° 45'	A, 254° 45'	At D: L, 120°
F, 110°	C, 309°	At D: K, 242°
G, 139°	D, 315°	
H, 171° 30'	E, 347°	At F—C, 322° 45'

To plot the bearings taken from A the protractor is adjusted with its centre at this point and its graduated edge to the east. The positions of all the bearings under 180° are marked off, and fine lines of indefinite length drawn through them from A, as shown; those over 180°, if any, would next be protracted

The point at which the bearing is to be laid down may be so near the edge of the paper that the graduated edge is off it. In this case lay the protractor with the graduated edge inwards, and produce the required bearing outwards *through* the centre

33. The bearing from one point to another on a map or sketch may be read by means of the protractor as follows:—If the true bearing is required, a meridian, or line parallel to the true north and south line, must be drawn through the initial point; if the [illegible]

map cuts the graduated edge of the protractor gives the reading in degrees If it is necessary to lay the graduated edge to the right or east, in order that the line between the two points may cut it, then

34. *True and magnetic bearings*

(*See* definitions, Chapter II)

Sometimes one of these is given and it is required to convert it
ng the variation as the case may
orders true bearings are given
The reason for this is that most
own, due to imperfections of
manufacture, independent of the magnetic variation It is, therefore, necessary to ascertain the exact variation of a compass when it is first obtained and to check the variation periodically.

as described in para. 33. The difference between the true and the magnetic bearings gives the variation of the compass.

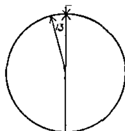
35. The beginner may be puzzled in converting true into magnetic bearings or in finding the variation of the compass unless he draws a figure.

Examples.

(1) The variation of the compass is 13° West. The magnetic bearing of a point P is 29°. What is the true bearing? First draw

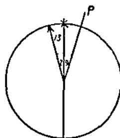
a circle and mark on it the known facts, *i e.*, the position of the true and magnetic N. Points, thus .—

FIG 8.



As the bearing given of the point P is a magnetic bearing, lay the protractor with the arrow-head at the centre of the circle and its edge along the magnetic N line Then measure off 29° to the east and mark in the point P

FIG 9

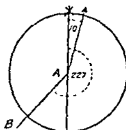


The position of P with relation to the true N. can then be read off viz 29°—13°=16°.

(2) True bearing A to B is 227°. Variation of compass is 10° E. What is the magnetic bearing of B from A? Proceed as in Example (1).

First draw the circle, put in the true and magnetic north. Then measure off 227° from the true north line, this gives the position

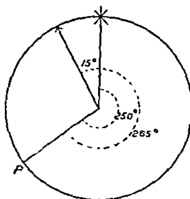
FIG 10



of B The magnetic bearing of B from A can then be seen to be $227° - 10° = 217°$.

(3) The true bearing of a point P is 250°, the magnetic bearing of the same point is 265°. What is the variation of the compass?

FIG 11.

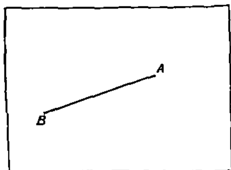


Draw the circle and the true north line. Then measure off from the true north line the true bearing of P, *i.e.*, 250°. Mark in P. Now start from P and measure off 265° from west to east, *i.e.*, lay the

protractor along the line from the centre of the circle to P, with
[illegible]
[illegible]
[illegible]
the left or west of the true north, the variation is 15 W.

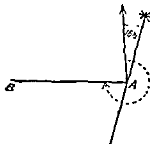
(4) You wish to find from an Ordnance map the magnetic bearing of a point B from a point A Variation of compass is $16\frac{1}{2}$ W.

FIG 12.



Join the two points by a pencil line. Through A draw in pencil true and magnetic N Points Measure with the protractor the angle (by E and S) between the magnetic N. and B.

FIG. 13



CHAPTER VIII

Approximate Methods of Finding the True North.

36. i With a compass, if the magnetic variation, which can be obtained approximately from Plate 15, is known.

ii. In the northern hemisphere, in ordinary latitudes, the true bearing of the Pole Star is always within 2° of north

iii. In the southern hemisphere the Southern Cross may be used as follows —Consider the Southern Cross as a kite, prolong the greater axis 4½ times in the direction of the tail, and the point reached will be approximately the South Pole of the heavens If a piece of paper be marked off along its edge by twelve dividing lines giving eleven equal divisions and be held so that the first and third divisions coincide with the head and tail stars respectively, the intersection of the twelfth line and the edge of the paper will give the approximate south point.

iv. At the equinoxes (end of March and end of September) the sun rises due east and sets due west.

v. At *apparent noon the sun is on the meridian* Apparent noon may, however, differ from mean local noon (12 o'clock by a watch) by as much as 16 minutes Moreover most countries now keep standard time of some particular meridian for use in railways and telegraphs throughout the country so that the time in actual use may differ considerably from the mean local time. At noon by the watch the sun may be a considerable amount off the meridian.

vi. *In the Northern Hemisphere*—Hold the watch horizontally with the face upward. Point the hour hand at the sun Then a line from the centre of the dial to a point halfway between the figure XII and the pointer of the hour hand is approximately a south line.

In the Southern Hemisphere—Hold the watch as before, but in this case point the line from the centre of the dial to figure XII at the sun, then the line found as above is in this case approximately a north line

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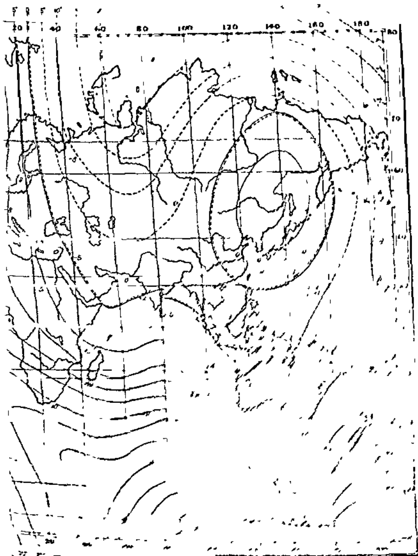
ıC VARIATION, 1912.

Plate 15

the

To face page 40

·E IN MINUTES OF ARC



This method is a very rough one. It should never be used in the tropics, and the higher the altitude, *i.e.*, the further from the equator, the more reliable it is.

NOTE —None of the methods given in para. **36** is to be used for determining the magnetic variation (*see* para. **34**).

CHAPTER IX.

MAP READING.

37. Proficiency in map reading is attained when the study of a good map enables the student to visualize in imagination the country portrayed Maps vary greatly in style of reproduction, and in the amount of information they convey. Notwithstanding their great military uses, they have their limitations, and should never be considered a complete substitute for the examination of the country itself. As already explained, dependence on active service will have to be placed on maps of small scale The smaller the scale the less completely can a country be portrayed in detail. Even with the best large scale maps, valuable military information as to the form of the ground, more particularly as regards underfeatures, may often not appear Generally speaking, maps are more lacking in complete information as regards form than as to detail. The expense of close contouring being prohibitive, it would be exceptional to get a 6-inch map contoured at 20 feet vertical intervals Even were it so contoured, such a map could not be used in substitution for a visit to the ground to determine exactly where a firing line could best be placed, or precisely what concealment the ground in [illegible]

particularly the case with gently undulating country, and sunk roads. It will, therefore, be seen that maps are an aid to, not a substitute for, the study of the country itself.

38. On taking up a map, look at once for the scale: this is the key to distances. Then carefully examine the heights and the

method of showing the form of the ground With contoured maps (the most useful) the vertical intervals used should be noted, as well as spot levels that may indicate under-features. Some maps show only spot levels These will be found generally on the heights, along main roads, along railways, at villages and sometimes in valleys and other situations. This method of scattered levels is generally combined with a pictorial method of shading

Plate 5 shows contours, vertical hachuring, and spot levels

Plates 6 and 12 show maps on the layer system

Plate 10 shows a German map, Plate 11 a French map, with spot levels and vertical hachures. The heights in both cases are shown in metres (Scales of kilometres altered to show miles)

39. A failing in many uncontoured maps is the sparse number of levels given in valleys, or at the foot of hills, the tops of hills are

40. An important item to look for on a map is the direction of true or of magnetic north In all descriptions made with reference to a map, the points or degrees of the compass are used to express the direction of one object from another In the small scale maps of the Ordnance Survey the sheet-line margins are rectangular and are drawn parallel to a central meridian. For sheets through which this meridian passes the marginal lines are nearly true north and south, with the north towards the top of the sheet; but for sheets to the east and west the margins deviate from the true north, the maximum deviation, however, in the extreme east and west counties is not more than 4° east or west respectively Where

See 9, vii)

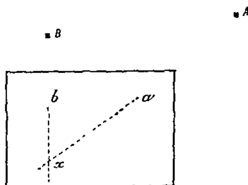
41. A map is said to be "**set**" when it is laid out to correspond with the ground, so that the true north on the map points to the North Pole If the directions between features on the ground be now compared with these directions as shown on the map they will be seen to be parallel.

a on A and draw a line towards yourself, then align the ruler through b on B and draw a line towards yourself. The intersection of these lines x is your position.

This process is called *resection* (*see* definition, Chapter II), and is of the greatest use both in map reading and in sketching, for by means of it an observer can find his position from two known points.

The service prismatic compass can be used for resection as follows (*see* Fig. 14):—

Fig. 14



An observer standing at x identifies two points a and b, which

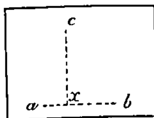
taken from the observer's position at the stations identified on the map or sketch with the protractor reversed, *i e*, turned to left or west for bearings under 180°, and to the right or east for bearings over 180°.

In fixing a position by resection, the angle made by the [illegible] section ($a\,x\,b$, Fig. 14) should not be too obtuse or too acute, i.e. [illegible] angle should not be greater than 130° or less than 50° if the [illegible] is to be accurate.

ii. When your position can be identified as in line with [illegible] known points or on a given straight line, such as a road, [illegible] canal, &c, and one point can be identified in the country [illegible] side of the given line, set the map

FIG 15

C



A

B

Then if A and B be two points on the ground in line with the observer's position, identified as a and b on the map, and C be a point on the ground on one side of A B, identified as c on the map, align the ruler through c on C and draw a line towards yourself; the intersection of this line with $a\,b$ at x gives your position.

43. Map Reading on the Ground.—Having mastered the various methods and artifices used in making maps, the student should then go out, and from some high post of observation compare large and small scale maps with the ground. Two methods of study should be alternated:

[illegible] carefully in detail for some time, say, [illegible] [illegible]. Then look at the country [illegible] [illegible]dy of the map, use a scale, [illegible] [illegible]ts; and from your position [illegible] note the general form of the ground as portrayed on the map, the directions of valleys and spurs, relative heights, steep slopes, the probable dead ground, woods, &c.

ii. Have a good look at the country first. Estimate distances and heights. In your mind convert distance into inches according

'ou expect
what the

44. *In the above exercises, all errors made should be carefully* thought out More will be learnt by systematically working the mind and imagination than by immediately looking from the ground to the map, or vice versâ. Moreover, the second exercise of visualizing the map from the ground is excellent training for sketching.

The above exercises should be carried out with both large and small scale maps for the same country. It is instructive, for instance, to compare on the ground a 1-inch map with a $\frac{1}{2}$-inch map.

45. Small scale maps, *e g*, $\frac{1}{4}$-inch, are apt to puzzle the beginner *in a country so full of detail as England. Much detail is* necessarily omitted on such a map. Thus, in traversing a road, he may find small by-roads omitted, and feel puzzled because he cannot estimate his progress by merely counting each turning met with. It is a help to check oneself by time as a measure of distance. If the map shows the next cross road a mile ($\frac{1}{4}$ inch) ahead, it will take about 20 minutes to walk · so if a cross-road is met with in 10 minutes, it may safely be considered to be some road other than the one on the map. Again, short but decided bends in a road often are not shown; whilst all curves and bends

streams it appears that the ground falls generally in a N.N.W. direction towards Beckford. Just S E. of Oxenton Hill is a detached knoll marked 531, and a spur runs out from this knoll in a direction slightly east of north. From the course of the stream, which passes by the *G* of Gretton Field, it may be assumed that this spur passes through the copse marked just south of the *n* in Alstone, and

ends in the sharp bend in the river south of the *s* in Little Washbourne West of this spur there is obviously a re-entrant, with its head at the col connecting knoll 534 with Oxenton Hill, and it

There is clearly a spur running N.N W. from Alstone towards Beckford dividing the Little Washbourne stream from the next small stream to the west Thus, though this ground is shown by an even wash of colour, the map clearly indicates that it consists of a series of spurs and re-entrants, and not of one even slope

If the reading of small scale maps be practised in this manner, they will be found to contain a mass of information which is not apparent to the untrained eye.

46. It is occasionally useful to ascertain from a map whether certain points shown on it are mutually visible on the ground. The best methods of doing this are given in Appendix IV.

CHAPTER X

General Principles of Sketching.

47. The essentials of a military sketch are :—

i It must be relevant to the object for which it is undertaken.
ii It must be clear and legible.
iii It must be completed in time to be of use.
iv. It must be as accurate as circumstances permit.

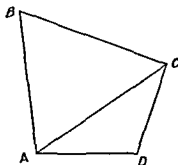
48. The main principles which underly all map-making, from the most accurate survey to the roughest sketching, are the same. Let us suppose that a representation on paper is required of a given piece of country. It is obtained by first "fixing" on the paper to a given scale the relative positions of a certain number of points on the ground, and thus constructing a framework or skeleton on which we can "hang" the details that lie between the points. These details are filled in subsequently by rougher methods.

The selection of these points of the frame work, or "ruling points," as they are called, is the primary stage in the construction of the map or sketch. They will be points which are most clearly defined on the ground, such as hill-tops, tall trees, church spires, &c

The distance apart of the ruling points, will depend on the type of the map being constructed, but for sketching purposes it may be taken that all conspicuous well-defined features will be utilized as ruling points—the more that can be "fixed" the better, the idea ... hance is there ... eye ... of the two ... traversing.

49. Triangulation.—In this method we consider our ruling points as making up a series of triangles Say we have four ruling points—A, B, C, D,

Fig 16.



where C is visible both from A and B, and D from A and C. If we measure A B on the ground, and by some means or other observe ... to any given scale, ... position of C. ... e anglas D A C and ... length A C on the ... d on the paper), fix

the position of D; so it is seen that, by measuring one distance between two given points and taking angles from the various points to each other, we can fix the position of any number of ruling points.

The measured distance, in this case A B, is known as the "base," and the points fixed by taking angles are known as "intersected stations" or simply "intersections"

[illegible] herwise the "rays" [illegible] angle." To obtain [illegible] as possible.

50. The usual method of measuring distances, such as the base A B, is by pacing The beginner before starting work should pace some known distance several times so as to ascertain the number of paces he takes to, say, 100 yards With a little practice a man of ordinary build can acquire the habit of pacing yards with sufficient accuracy for practical purposes.

51. Rays may be taken either with a ruler (straight edge) or with the prismatic compass. The former method is the simplest and quickest, and is sufficiently accurate for such field sketching as is required of the regimental officer The ruler is pivoted on the point from which the observation is to be taken, say A (Fig. 16), and then aligned on the ruling point which it is desired to fix, say B. A line is then drawn from A to B In fixing the position of A on the paper it is necessary to consider the general shape of the area to be sketched. This may be done either by examining a map or by looking at the ground. The position A is then chosen so as to bring the whole of the area on to the paper

As soon as the ray A B is drawn a compass should be placed on the paper, while the ruler is still pointing from A to B, and the magnetic north line be marked on the paper.

In taking all future rays the sketch should first be set as described in para. **41.** Rays are then taken from A to D and C, the other visible ruling points.

We then proceed to B, which is fixed by pacing, and after setting the sketch take a ray to C. The intersection of the rays A C and B C fixes C.

In practice it is not necessary to draw continuous rays. It is sufficient to mark the intersection. To obtain good intersections the angles made by the rays should be between the same limits as in

resecting (para. 42), i.e., between 50° and 130°. As soon as two or more ruling points have been fixed, other points from which such ruling points are visible may be fixed by resection as described in para. 42.

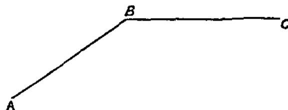
52. Intersections and resections may be made by means of the prismatic compass, bearings being taken as described in para. 27, and plotted as described in para. 32. This method is usually more accurate than the method of taking rays with a ruler, but is much lower.

Fig. 7, p. 34, shows a base A B and stations C, D, E, F, G, H, L, K, fixed by intersection.

53. **Traversing.**—This method will usually be confined to cases where the ruling points are not mutually visible, e.g., in bush country, and so the triangulation method of intersections is not possible. It is also more suitable when the sketch is one of a "route," e.g., a road sketch, rather than of an "area."

Say we have three points A B C (Fig. 17) which we wish to fix we can see B from A, and C from B, but not C from A. If A is not

Fig. 17.



already a fixed point on the sketch we plot it in any convenient position on the paper; we then observe the "direction" of B from A by some means or other, and measure the distance A B.

If we plot the direction on the paper, and measure off the distance A B to scale, we have the position of B. We can then proceed in a similar manner to fix C.

CHAPTER XI.

Sketching with a Cavalry Sketching Board.

54. The cavalry sketching board is a small board which can be strapped to the fore-arm. A magnetic compass is fixed in the board. Two rollers on opposite sides of the board enable a long strip of paper $7\frac{1}{8}$ inches wide to be carried, the paper being unwound from one roller and wound up on the other as the sketch proceeds. The rollers can be clamped by rotating their ends in the direction noted on the board

The compass is fitted into a circular metal collar in which it revolves A fine index line is marked across the glass, which can be adjusted to any required position by turning the glass. Before commencing to sketch it should be so adjusted that when the index line coincides with the needle, the direction of the paper is that of the general direction of the route to be followed.

On the back of the board is a clinometer graduated to 50° and protected by a sheet of celluloid In order to measure any slope the board is held upright with its straight end parallel to the slope, and the clinometer is freed by pressing the knob On releasing the pressure, the clinometer is clamped and the slope can then be read off.

55. The cavalry sketching board is suitable for mounted or dismounted sketching On horseback it should be strapped to the left arm, midway between elbow and wrist. The left hand (the bridle hand) should be kept high, to prevent the board from knocking on the pommel of the saddle. When sketching on foot the straps should be held firmly in the left hand, which should be close up to the back of the board, so that the board may be revolved on the forefinger and thumb.

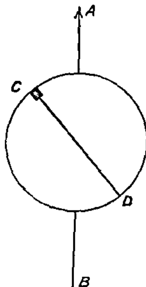
56. Setting the Compass. Before starting work the compass should be "set" so that the direction of the road runs generally up the length of the paper. The general direction of the route may sometimes be seen from the starting point. If not, its magnetic bearing may be given, or its true bearing may be taken from a map.

i. When the direction is seen.—Turn the board so that the "line of direction" marked on it points along the direction of the route. Holding the board steady, move the line marked on the cover of the compass until the knob end is over the north point of the needle.

ii. When the magnetic bearing is given.—At first ignore the needle. Put the line on the compass cover on the "line of direction," the knob end towards the roller containing the sketching paper to be unrolled when at work; then turn the knob backwards (*i.e.*, by west) through an angle equal to the bearing given. Then when the board is turned until the knob end of the line on the cover of the compass is over the north end of the needle, it is set.

This may be explained by means of a diagram as follows.—

FIG. 18.



Here A B is the line of direction on the board, the circle represents the compass and C D the movable line on the cover, with the

knob end at C Suppose the magnetic bearing given as the general direction to be followed be 40°
whenever the board is set, the bea
40°. To do this we move the line
with the line of direction A B with the knob pointing the way we wish to go. Then we move the knob end of the line 40° to the west, or in the reverse direction to the readings of the compass. Now whenever the board is turned so that the magnetic needle coincides with the line C D, the north point of the needle being under the knob C, C becomes the magnetic north and the bearing of the line of direction A B becomes 40°, which is what we want.

If in the course of the work the sketch runs off the paper,

sketch.

57. The following rules should be observed when sketching, either mounted or dismounted, with the cavalry sketching board:—

i Turn the horse, or body if dismounted, in the direction of the object

ii. Revolve the board until it is "set" by the compass.

iii By moving the left arm or hand to the right or left, bring the

away from you It is well to take a second look at the

Any slight alteration of the position of the board, in order to obtain a more exact coincidence of the needle and the index line, is best accomplished at this juncture by gently turning the left wrist and forearm.

The correct alignment of the ruler on any distant point is a matter of judgment and "eye." With a little practice the ruler can be aligned, and the direction drawn in, correct to within 2° or 3°, in between 10 and 20 seconds

Most horses soon get accustomed to the work, and will stand steady enough for a brief period immediately after being reined up

After a little practice the ruler can be dispensed with, except for long "shots," and the directions of objects drawn in by placing the pencil point at the place representing the position of the observer and drawing a line in the required direction.

58. Accurate work is not expected with this instrument, but for

Chapter IX The position of prominent points off the route may be fixed by intersections, taken from stations on the route, the position of which has been fixed by traversing

The **forward bearings** should be taken to the furthest *visible* parts of the route, irrespective of distance.

In settled weather an aneroid barometer may be used for fixing levels (*See* Appendix II

The clinometer on the back of the board is of use for measuring slopes roughly in the vicinity of the sketcher.

59. The principal use of a horseback sketch executed as above is to serve as a diagram to illustrate a road report The report being the essential part of the work, the sketcher must make notes as he rides along, and must generally be on the alert. It is, therefore, not desirable to count paces, for this system is vexatious and laborious *and prevents the sketcher from studying the country through which* he rides. For the above reasons the best way is to measure distance by *time*

Allow 12	miles	an hour for a	canter,
8	„	„	trot,
4	„	„	walk,

under normal conditions.*

Then draw a scale of minutes at the trot on the ruler. Thus :—
Scale of sketch 2 inches to 1 mile,—

In one minute at a trot $\frac{8}{60}$ mile, or 235 yards, will have been covered This distance
scale on the edge of
will be represented by

In using this scale at the walk, halve it. When walking half the time and trotting the other half, take three-quarters.

* Practice in keeping the horse at an even pace is essential.

If it is known that the particular horse which is being ridden has not got the normal speeds, a special scale should be made.

The best pace to work at is a steady trot.

60. The cavalry sketching board is also very useful for work on foot, particularly when completing a previously prepared enlargement (*see* Chapter XII) It may also be used for making a road [illegible]

revolution, and to prepare a scale of cycle revolutions accordingly.

CHAPTER XII

Enlarging Small Scale Map and Adding Extra Information on the Ground —Reports.

61. The methods to be employed in enlarging an existing map to a larger scale have been described in Chapter VI, and exemplified in Figs 5 and 6.

It may be expected in most future wars, that officers will be in the possession of small scale maps But it is not possible on a small scale map to indicate satisfactorily the positions of small bodies of troops It must also be remembered that maps are rarely quite up-to-date, and that maps on small scales necessarily omit details and certain tactically important information. It will therefore sometimes happed that a map on a larger scale is necessary, and this is obtained by enlarging the small scale map. It will now be [illegible]

value, in order to allow of greater space for the inclusion of new information, but care must be taken that nothing essential is omitted.

62. The best results are usually attained by the following procedure:—

(*a*) Carefully study the tactical object involved with the aid of the $\frac{1}{2}$-inch map provided

(*b*) Bicycle or ride rapidly over the ground, or to such high points as it is necessary to visit in order to appreciate with the aid of field glasses what special information is wanted.

(*c*) Enlarge that portion of the $\frac{1}{2}$-inch map selected for the sketch to the required scale

(*d*) *Fill in the enlargement on the ground*, chiefly by eye sketching, and make the necessary notes.

(*e*) Finish off the sketch, and, if necessary, add a report.

63. With regard to (*d*), where the map contains a number of well-defined features, the position of which can be fixed upon the enlargement, the details of the country between such points can usually be sketched in by eye without difficulty When, however, the map contains few features, the position of which can be definitely fixed on the enlargement, it will usually be necessary to fix some additional ruling points either by triangulation or by

hich can
complete
o fill in
be able
that he

need not go over the same ground twice

64. The formation of the ground can be shown more completely than is possible on a small scale map by the interpolation of form lines, *i e.*, approximate contours, between those obtained from the enlargement; slopes being shown as explained in Chapter V, *e g*, if the enlargement shows contours at a vertical interval of 100′ intermediate 20′ form lines can be put in by eye

not uniform the approximate place where the slope changes should be marked on the sketch, the steeper portion of the slopes being

case, and it is desirable to keep the mind alert to examine and treat eac' [illegible]
he: [illegible]

68. In drawing up his report the reconnoitring officer should be as concise as possible, and should be careful to confine his information to what is relevant

The most satisfactory method is to divide the report into two parts. The first part should contain a general description of the outstanding features of the reconnaissance, to enable the reader to get a grasp of the subject without having to wade through a mass of detail The second part should contain the details in tabular form For the same nature of reconnaissance (road report, river report, etc) the headings in Part II, should usually be the same; those in Part I, however, should be varied according to the tactical object of the reconnaissance The disadvantages of a cut-and-dried form are counterbalanced by the greater ease with which items of information can be turned up or reports collated

Where the names of foreign places or towns are spelt in various ways, the anglicised form should be used, followed by the local form in brackets

Care should be taken to distinguish between what are impressions or hearsay only and what are facts.

69. *Road reconnaissance.*

i The information should supplement that given on the sketch, and not repeat what is already shown

ii The information should be definite, *e g*, it is not enough to know that animals can be watered in a stream, but the numbers for which there is room, its depth, etc , must be given.

iii. *Tactical Information* — Definite information is specially impor- [illegible] Thus it is not sufficient [illegible] position Information [illegible] of the position and force [illegible] ont and flanks, and of

soil for digging; localities which would form strong defensive points, artillery positions, own and enemy's, what the view is like, point from which an extended view is obtainable and the average field of fire; best lines of attack and counter-attack; communications and water.

In order to make a good tactical reconnaissance it is advisable, before starting, to find out with what "special idea" the reconnaissance is to be undertaken

iv. *Road Details.*—Roads should not be classified solely by their width, though information as to their width may be inserted (see para. 13). The surface condition and material for repair must be considered The ease with which troops can deploy from them is important. The nature of the fences or ditches enclosing the road should be mentioned.

v. *Gradients.*—Only such gradients should be mentioned as will affect the rate of marching

vi. *Bridges* —It is not necessary to give details of every culvert, [illegible] should be fully reported on, [illegible] mechanical transport, [illegible] th, height above ground [illegible] be noted.

vii. *Turnings* —Mention turnings only when they present some difficulty, *e g.*, through a town where the names of the streets should be given.

viii. *Observation Points* —Places from which a view can be obtained should be noted, with the direction and extent. The names of distant objects that can be identified should be mentioned, such as churches, country houses, &c.

ix. *Local Administration.*—System of local administration should be noted; the identity of influential individuals or functionaries should be established.

x. *Supplies* —For a thorough report on a district an expert is alm[illegible] non[illegible] tow[illegible] large number of farms.

In the former seek for flour mills and find out the normal amount of grain kept in stock From the butchers ascertain if the locality is self-supporting, or if much frozen meat is brought in. For groceries find out the biggest firms, and ascertain at what intervals of time

stocks are renewed the date of the last order will show how long present stocks will last. Find out how many rations of tea expressed in ¼ oz. and of sugar in 4 oz he has in hand, the lower number of the two divided by the number of days the stock is estimated to last will give the approximate number of consumers This enables the number of grocery rations obtainable to be estimated, as other groceries are usually present in sufficient quantities.

HEADINGS FOR PART II

Place	Distance in Miles.		Details of Road	Remarks.
	Inter-mediate	From		

70. *River reconnaissance.*

ii The headings in Part I will vary according to the tactical object, those in Part II, which contains nothing but facts about the river, need not vary.

iv. Ice 3 inches thick will bear men in small detachments; 6 inches thick, horses and carts; 9–12 inches thick, wagons and guns.

HEADINGS FOR PART II.

Crossing	Details	Fit for mechanical Transport	River			Quays		Boats and barges usually available	Approaches		Remarks
			Breadth yds.	Depth ft.	Velocity m per hr	Right bank	Left bank		Right bank	Left bank	

71. *Railway reconnaissance.*

i It should be borne in mind that an expert would be required to write an adequate report on which to work a railway.

ii. *Stations* —In ordinary circumstances a rough sketch of the stations, on which the following information is shown, would suffice —The approaches, number of lines; cross-overs; number, length, breadth, and height of platforms; number and length of sidings; water; turntables; end-loading and other ramps; goods sheds, lighting

iii. *Forming-up places*—Places suitable for forming-up troops before entraining or after detraining, with their area, approaches, water supply, &c, should be reported.

v. *Track*—As regards the line itself, the gauge, any unusual gradients, type of fuel used, any triangles, and details of any bridges of importance should be noted In case of a single line the distance between crossing-places.

73. *Billeting reconnaissance.*

[illegible] ulation of
[illegible] taken as
[illegible] umber of
[illegible] imber of
vehicles per inhabitant should also be given

ii Billets without subsistence can be provided at varying rates

The best class of village in a rich agricultural district will take up to 10 men per inhabitant; a residential town or village with good houses and wide streets about 5 men per inhabitant; while industrial towns with a dense population and a poor type of house will take still fewer.

iii There are various questions affecting billeting, such as supplies, railways, &c: as a rule, these subjects should be treated generally in Part I. of the report, details only being given when particularly required.

iv. Particular care should be paid to giving details concerning the water supply, any large buildings, such as schools or country houses, which will accommodate a considerable number of troops, and any open spaces where troops can collect or vehicles be parked.

v. In many civilized countries chief officials of localities keep detailed lists showing billeting accommodation. Efforts should be made to obtain these.

vi. In a billeting report based on the population of each parish, the small hamlets in each parish should be mentioned by name, as well as the parochial headquarters

PART II.

Name of Parish, Town, or Village	Pop	Billets			Nature of surrounding country	Water Supply.	Railways.	P O	Supplies	Remarks.
		Men.	4-horse vehicles	6-horse vehicles.				Tel O. Tph O.		

74. *Reconnaissance of an enemy's position with a view to attack.*

The following are the chief points on which information is desirable :—

i. The general front of the position, so far as it can be ascertained The probability of advanced troops covering the real position will have to be considered.

ii. Points from which a good view of the country occupied by the enemy can be obtained.

iii. Localities to which the enemy is seen to be devoting attention, and any others which would appear likely to be of special tactical value to him. The position of any trenches, obstacles, &c., that can be located should be carefully noted.

iv. Lines which afford the attack most cover during their advance and which offer facilities for covering fire, both from guns and rifles, where it is exposed to hostile view and fire.

v Tactical points on the above lines of advance and elsewhere, the possession of which will favour the development of superiority of fire over portions of the enemy's position

vi. The manner in which the flanks are secured, whether they rest on natural obstacles or whether there are any indications of supporting troops and works echelonned to the rear

75. *Defensive reconnaissance.*

When it is intended to occupy a defensive position, with a view to subsequent offensive action, the chief points to be noted are —

i. The extent of the position, the localities of special tactical importance in it and the means of securing the flanks.

ii. The minimum force necessary to occupy the position

iii The positions for the artillery and for the infantry firing lines These should be considered together, so that the best use of the ground may be made

iv The best line or lines for the counter attack.

v. The most favourable lines for the enemy to attack on, and positions from which his artillery can best support such attacks.

vi. Any tactical localities, the possession of which might enable the enemy to develop superiority of fire against some part of the position.

vii. Any advanced position, the occupation of which might have the effect of misleading the enemy and forcing him to a premature deployment.

76. Notes on the way to finish up sketches will be found in Appendix III

CHAPTER XIII.

Eye and Memory Sketching

77. Although it is improbable that an officer unprovided with

an officer in command of an outpost company, he would probably

have to furnish to his superior officer a sketch of the ground on which his troops were disposed Moreover, a plan-sketch is a useful addition to any written report

Without any instrument whatever, it is possible to execute, with fair accuracy, a plan-sketch which from a military point of view may prove of considerable value The making of such a sketch is much facilitated by the mastering of the principles of sketching described in Chapter X

The sketcher requires a pocket book, such as Army Book 153, or a flat board, and ruler

Board.—A piece of board of convenient size, a smooth-covered book, the lid or a biscuit tin, or any similar article to which a sheet of paper can be attached (To keep the paper stretched over the board, or other article, perhaps the simplest way is to secure it with two pieces of string, tied tightly round paper and board at either end)

Ruler.—A slip of wood, or stout cardboard, with a straight edge.

Not being provided with a protractor or a scaled ruler, the sketcher must construct a scale to which to draw his sketch The scale to be adopted for any sketch depends on the area of the country to be sketched, and on the size of the sheet of paper available

the sc[illegible]
pocket
being
most officers' pocket books squares of a certain size are ruled on the pages; *e g*, in Army Books 152 and 153, the squares are ¼ inch. If, therefore, a book of this kind is available, a ready-made scale is at hand, otherwise a scale must be thought out.

The sketcher should d[illegible]

scale should be drawn at t[illegible]
If at some future time a fo[illegible]
kind, divided accurately ir[illegible]
yards to the inch can be
worked out.

It is useful to remember that the lines on a sheet of ruled foolscap are as nearly as possible one-third of an inch apart. So a strip of such paper, cut lengthways, makes a handy scale, the intervals between the lines being approximately equal to 100 yards on the 6-inch scale, 150 yards on the 4-inch, 200 on the 3-inch, 300 on the 2-inch, and 600 on the 1-inch Another useful measurement to know is that the diameter of a halfpenny equals one inch

78. The sketch is executed by first arbitrarily fixing on the paper a point to represent the position of the sketcher.

Then, pivoting his ruler on the point thus fixed on the sketch, he aligns the ruler on distant points, and draws rays on his sketch in their direction.

It is necessary for the sketcher to get his eye well down along the alignment of the ruler so that the direction of the ray may be obtained as accurately as possible

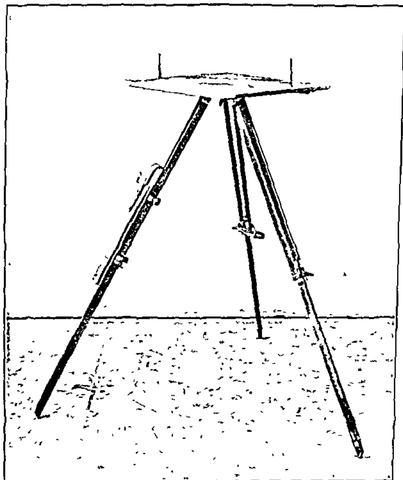
The detail required on the sketch is filled in before the sketcher moves from his position. Having completed this, he marches in the direction of a point whose direction is fixed by a ray on the

in around his new station.

79. It will often happen on service that reconnaissances have to be made under conditions which make any sketching on the ground impossible In such circumstances a memory sketch will often furnish a useful complement to a report When possible rough

In observing ground with a view to making a sketch of it subsequently from memory, it is important to distinguish between the essentials for the purpose of the reconnaissance and details of minor importance. No attempt should be made to burden the memory with the latter.

To face page 67



PLANE-TABLE, PORTABLE, MARK II, 18 INCHES SQUARE

PART II.

CHAPTER XIV.

Plane-table Sketching.

The plane table.

Note.—*The use of the plane-table at the military colleges is authorized for the purpose of teaching cadets the elementary principles of the construction of a sketch*

80. The plane-table is merely a portable table. The table or board can be carried separately from the stand, and when fixed to it can be turned round to "set" the sketch without moving the legs. The stand is usually a folding tripod, and, for greater compactness, is sometimes collapsible The adjuncts to the plane-table are the sight-rule and the trough compass, the plane-table should also be provided with a waterproof cover.

81. The sight-rule should be about as long as the shortest side of the table, and the fittings should be of gunmetal or brass, not iron or steel A common de[illegible]
rear vane is too small.
of the tops of the vanes
the vanes are upright, to enable rays to be taken on steep slopes. It is convenient for the sight-rule to be graduated with useful scales, for instance, 2 inches to 1 mile, as in the Service pattern

82. The trough-compass [illegible]

prismatic compass can be used instead.

83. Mounting a plane-table.—With an ordinary plane-table which has a plain board, pin the paper on to the board with drawing-pins. All arrangements of clips should be avoided.

84. The plane-table is the most accurate instrument employed in making military maps and sketches and it is important that the student should master the methods described The following are *general maxims* which should always be observed —

i See that the leg-screws and clamping-screws are taut before beginning work

ii Spread the legs of the table widely, especially with collapsible patterns (since the steadiness of the table largely depends on the *spread of the legs)* *In soft soil the legs should be well pressed into the ground.* The board should be horizontal

iii Always keep the pencil sharp, there should be no error in

dots surrounded by a circle.

iv When it is required to draw a ray from a point, put the pencil upright on the table with the edge of the base just touching the point, and lay the sight-vane against the pencil. Instead of a pencil, some expert plane-tablers use the finger; but pins would not be used by a good plane-tabler

v. When drawing a ray from a point on the sketch, set the point of the pencil into the point first, so as to get the correct angle at which the pencil should be held when drawing it along the sight-vane Without this precaution large errors creep in

vi. Whenever the plane-table has to be set up or oriented by a

which to lay the sight-vane

vii When drawing a ray to a distant object, mark its approximate position, as estimated, by a small circle on the ray. Write the name of the object along the ray.

viii. In making an intersection with a second or third ray, it is not necessary to draw the whole ray. About a $\frac{1}{2}$ inch of it across the point of intersection will suffice

ix Never set the plane-table by the compass if you can set it by an alignment on some distant point or points already fixed

85. The steps to be taken in making a plane-table sketch are as follows:—

i **Select a Base Line.**—This should be on level ground It should occupy a fairly central position, though this is of no great importance

Both ends of the base should be visible from well-marked natural points in the area to be surveyed, and from each other.

The length of the base would usually be from $\frac{1}{2}$ mile to 1 mile, but the longer the better. A good rule is that the base should be about 2 inches long on the paper, but this is longer than can usually be obtained. If possible mark the ends of the base; or, if this cannot be done, measure between existing points or objects; or else measure in the same line as two existing objects A base is usually selected on high ground because its ends then afford good points of observation In some districts, however, where the higher ground is much wooded, and gaps are short, it is often better to select a base in an open valley. From this the prominent features of the hills on each side can be more easily fixed, and, when fixed, can be used as stations to fix detail in the valley.

ii **Measure the Base.**—This must be done by careful pacing, the accuracy of the triangulation depending on the correctness of the base.

iii **Fix Points by Intersection.**—The most suitable position for the base on the board must be carefully considered before commencing work; the amount of country to be surveyed, and the position of the prominent points required for resection, being taken into consideration.

Set up the plane-table at one end of the base, and draw rays to the other end of the base and to prominent obtects within the area to be surveyed, or not far outside.

Place the compass in its box c [illegible]
the compass until the needle poir [illegible]
then draw a line on the table at [illegible]
north end Remove the compass [illegible]
subsequently in the course of the work at intersected stations. Go to the other end of the base; place the sight-vane along the pencil line representing the base; set the plane-table by moving the board until the sight-vane is aligned on the first end of the base; then draw rays to the same prominent objects used before, thus fixing their position by intersection.

It may sometimes happen that one end, A, of a base AB, has to be selected because there is a prominent object there, but that a better station, C, is close at hand to take rays from. C has, however, no object to define it, *e g*, it may be in an open field It may be used to observe from by fixing its position from A. The board is set at A on B, a ray is drawn to a big stone or stick put at C, and the distance AC is measured carefully and plotted. The object at A can be used for resection purposes.

Next go to one of the points intersected which makes a well-conditioned triangle with the base, test its position by setting up by one end of the base and by an alignment on the other, and then draw rays to all the other intersected points which are visible and to any new points which may be likely to be useful Except in the immediate neighbourhood of the base, it is desirable that each intersected point should be fixed by three rays, particular care being taken to ensure the greatest possible accuracy in fixing points which may afterwards be used for resection

It is by no means necessary to cover the whole of the sketch with intersected points, but it is important that the positions and levels of ruling-points should be fixed, others being sketched in by eye to save time

It often happens that on proceeding to an intersected point, X (*e g*, church spire) the table cannot be set up over it, or the ground just there may afford no view of points you want to fix. The table should then be set up near it, and on a line between it and some other fixed point Pace along this line the short distance you are from X, plot it to mark the point over which your table now is, and work from it as a station

iv **Fill in the Detail; mainly by Resection.**—Resection from three known points, sounds a formidable process, but in reality *it is very simple It is the principal means by which the bulk of* the detail, which cannot be eye-sketched from intersected ruling-points, should be fixed

The method is as follows —

Set up the plane-table at any point from which three previously fixed points can be seen. Orient the table by the trough-compass, and from the three fixed points draw back-rays If these three rays pass through a point, this point is the required position.

If they do not pass through a point, the rays will form a small triangle called the "**triangle of error.**" The true position is now *to be determined by the following rules* —

I. If [illegible]

II. In the latter case the position will be such that it is either to the left of all the rays when facing the fixed points, or to the right of them all Of the six sectors formed by the rays, there are only two in which this condition can be fulfilled.

III. Finally the exact position is determined by the condition that its distances from the rays must be proportional to the length of the rays, *i e*, the position on the sketch must be nearest to that side of the triangle formed by the shortest ray, and furthest from that formed by the longest ray.

FIG. 19

1 2
6 3
5 4

In Fig. 19, for instance —

By condition I the point must be outside the triangle of error.
" " II " " " in sector 6 or in sector 3.

By condition III the point must be in sector 6,* since the distances from it to the rays must be proportional to the lengths of the rays, and by estimation it will be where shown.

Having thus determined the position, place the sight-rule along the line joining it and the most distant of the points used; set the sight-rule on the point by revolving the plane-table; clamp and test on the other two points If there is still ... should, however, be ...

The best positi... points, of which ... is distant Accuracy of position ... near, accuracy of *setting* is ... Generally fix from near

... to make fixings by this method both rapidly and accurately. It is the essential foundation of all rapid plane-table sketching The plane tabler in open country need not pace or measure a yard after he has fixed his base In addition to the speed which results from a free use of resection there is also a gain in accuracy, since there is no piling up of errors, and each fixing is dependent only on the main intersected or other well-fixed points.

When there are a number of points, any three of which may be used for resection purposes, recollect in choosing the point to be used that—

(1) When the three points chosen, and the observer's position lies on or near the circumference of a circle, the accurate determination of the observer's position is not possible by this method

(2) The three points chosen should be such that the rays from them do not intersect at acute angles, and thereby make a badly shaped triangle of error.

(2) Choose points which are most accurately fixed on the sketch (*e g.*, those of the base or directly fixed from ... Beginners ... be... wh... have not themselves been accurately fixed on the sketch The method, however,

* To make this clear, take a point anywhere in sector 3. It will be seen that it lies nearer to at least one of the long rays than to the shortest ray, and condition III would not be fulfilled.

is an absolutely exact and accurate one. It will have been
the
does
that
this should be remembered.

Two useful methods, which can often be adopted with good results, should be noted —

(1) If the sketcher can place himself anywhere on a line prolonged through two points previously fixed, he can set his board by them and fix his position on this line by resecting from any third fixed point which gives a good angle of intersection

(2) If on setting up at any point C it is noticed that a ray to some other useful point D has been omitted when at a

intersection of these rays is the position of D.

v **Resection from Two Points.**—It will sometimes happen that only two fixed points or stations are visible; in this case the plane-table must be oriented by the compass, and rays must be drawn back from the two fixed stations intersecting in a point which must be taken as the required position. It is clear that such a fixing depends entirely on the compass, and may, therefore, be very inaccurate. In parts of South Africa such a fixing would, on account of local magnetic attraction, be entirely worthless, and it is obvious that as a general rule compass fixings

drawn in; a combination of measurement and estimation should be used; the amount of estimation permissible will depend on the scale. Thus, on scales of 2 inches to 1 mile and smaller scales it

When time presses, minute accuracy must be sacrificed.

vi **Traverse Detail which cannot be fixed by Resection.** —It will sometimes happen even in open country that there are parts of the work, such as valleys and woods, in which plane-table fixings cannot be made, in this case it is necessary to have recourse to plane-table traversing Plane-table traversing has to be much used in flat country unprovided with prominent landmarks, and was used in the mapping carried out during the operations in China in 1901

The method is as follows —Set up the plane-table at some known point and orient it by some other known point that can be seen, the further away the better Then proceed as directed in Chapter X, fixing the direction with the sight rule, and pacing the distance

Traversing does not give accurate results, and should only be *used where unavoidable*

86. [illegible] plane-table to fix the [illegible] s sketched in [illegible] ere sufficient [illegible] Experience will teach the sketcher how to select the order in which he will visit ruling points, so as to end at one which affords a good view for sketching in by eye the remainder of each section

Beginners usually make the error of utilizing instruments too much in field sketching, and of fixing far more points of detail than is compatible with rapidity of work It is, therefore, important to remember that when ruling points are fixed correctly, small dis- [illegible] ared with [illegible] nation is [illegible] student

CHAPTER XV.

Panorama Drawing.

87. A useful branch of field sketching is the representation of a landscape in a conventional form, or the art of representing the country in elevation instead of in plan. Such sketches, which are

called panoramas, are useful to illustrate a report, and may add considerably to its value and clearness A panorama is often an invaluable adjunct to a report upon an artillery position, and may be of assistance when firing at moving objects from under cover, for switches, and in night firing (*see* Field Artillery Training).

It may be premised that, from a military point of view, it is not necessary to be an artist to produce a useful panorama. Indeed, it is better almost that the artistic sense should be absent, and that

[illegible] ld be looked at with a cold, [illegible] sketcher would note rather [illegible] ry purposes than it beauties of colouring or the artistic effects of light and shade.

The beginner often feels much discouraged because his first attempts are so unlike what he wishes to draw, but with patience and practice and a close attention to the hints in this chapter, he will find that in time he will be able to produce useful work Let it be understood that however rough the picture may be, it will still be useful if intelligently drawn. Another difficulty is that of drawing the trees, houses, &c, as they are seen in the landscape. Absolute accuracy in the details of their appearance is not essential. So long as the sketcher can faithfully produce the outline of the important military points of the panorama, the other details can be drawn in a conventional manner It is better to stick to bare

[illegible] cept such as is [illegible] Unnecessary [illegible] racts from its clearness

Let the beginner learn by degrees, drawing small and easy subjects to commence with, before trying anything too ambitious. Let him copy other drawings, and thus gain confidence in his own powers Plate 17 shows some examples of methods of drawing objects in nature in a conventional manner.

88. The sketcher should study the ground very carefully before commencing to draw it. He should make a free use of the field glasses or telescope to assist in resolving details which appear confused and in defining accidents of ground that are not clear to the naked eye. The more carefully the country is studied beforehand, the easier will it be to draw it. In commencing to draw a panorama, the first thing to do is to choose a suitable point of view from which to sketch it This depends on two things:—(*a*) The ex

country to be included in the panorama, and (b) a position from which a good view can be obtained. In a measure, these two conditions are closely associated. The wider the extent of the panorama, the further off must be the position from which it is drawn. It will be understood that the wider the visual angle, the more inconvenient it is to draw all that it includes, and it may thus be necessary to make a panorama of the country in two or more sections and to join them together afterwards

Having chosen the point of view, the next task is to draw the picture Here the beginner is confronted with a series of difficulties, some of which are —

i How to begin.

ii How to keep the dimensions in the picture proportionate to the apparent dimensions in nature

iii To overcome the difficulties of perspective, and to get the receding effect of distant objects.

iv What to include in the drawing and what to leave out.

To take these points in detail—

i First select the position from which the sketch is to be made. This should be some point where the sketcher can sit down comfortably with a good view of the ground on which he wishes to report The position should be as central as is convenient The beginner should use squared paper, such as that in Army Book 153 Until he has acquired some skill in the use of a pencil he should use two, one hard for drawing in the distance, the other medium for the middle distance and foreground A ruler about a foot long with a piece of string about one foot long tied round its centre, will be of assistance in measuring distances and angles.

ii. The next step is to settle the length of the panorama This depends on the extent of ground to be reported on, but if this is large it is not necessary or advisable to attempt to include the whole in one panorama As much as is convenient may be drawn from one point of view, and the remainder of the ground be shown in a second panorama, viewed from elsewhere, normally about one foot, *i e*, about the length of a double sheet of Army Book 153 when opened at the centre, may be taken as a convenient limit

Hold the ruler horizontally at such a distance from the eye that one end coincides with the left of the distance or skyline of the

country to be sketched, and the position of the thumb on the ruler with the right Now, without altering the position of the ruler, [illegible]

This is important as otherwise the results will vary.

Mark off on the paper the horizontal limits thus measured on the ruler, and then measure the vertical limits in a similar manner by holding the ruler vertically These vertical limits should be marked on both ends of the paper

Now consider the skyline carefully and select some prominent point on it as nearly as possible directly opposite to your position. The hill with the flagstaff on it in Plate 18 is such a point. Fix the position of this point by measuring its distance from the edge of the paper and its height from the bottom of the paper. From this point measure off the distances to other prominent points, such as the two fir woods on the skyline (Plate 18), measure carefully their relative heights, with reference to the bottom of the paper, and mark their positions on the sketch.

Next consider the middle distance and the ground near you. Select, if possible, some tall objects which cut the ground to be sketched vertically, such as the two railway signals, the side of house and the outer trees of the fir wood in the left foreground. Measure the distances with the ruler as before, and mark the positions of these objects on the paper with horizontal lines. If no suitable tall objects are available any prominent objects will do

In this way the positions of a number of ruling points are fixed, and a framework is made in much the same way as when making a triangulation

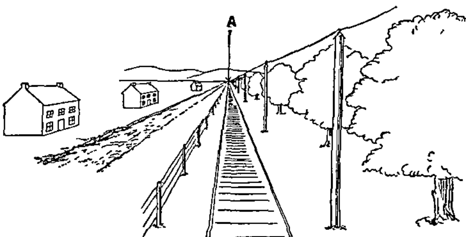
[illegible] rules will overcome this difficulty quite sufficiently for military purposes.

First of all, as regards the size of the objects. It will be noticed in looking at the landscape that, as objects are placed further off, they appear smaller. Therefore, make them so in drawing the panorama.

The further off the details in the country are, the thinner must be the lines with which they are drawn Thus—

In drawing the nearest part of the picture, use a medium pencil with thick strokes

Fig 20



A simple Example of Perspective
(The vanishingpoint A to be specially noted)

The middle distance, which lies between the foreground and the background, should be depicted in strokes of medium thickness, or with an ordinary pressure

Lastly, the background, or far distance, should be drawn in fine strokes with a hard pencil, or with one used with a very light hand.

In other words, the nearer an object is, the thicker and heavier the strokes with which it is drawn, and the further off it is situated, the thinner and lighter must be the strokes.

iv. What to include and what to leave out of a panorama is a matter of judgment, but the following points are of importance — All details that have any bearing on the military situation should be carefully drawn. For example, in making a panorama of an enemy's position, hedges, fences, &c, that would be held by him, or that would assist an attack, should be put in carefully Obstacles such as rivers, marshes, and so on, are of importance. Church towers and steeples, factory chimneys, outstanding and easily recognized trees, such as poplars being landmarks are useful. [illegible] the ground [illegible] importance, [illegible] not all the [illegible] en When [illegible] villages it is not necessary to put in every house, but to represent generally the shape and extent of the village, while carefully drawing the outline of any special feature that serves as a landmark, such as the church or a big house or building.

There is always a tendency to exaggerate the heights of hills, this must be avoided, as it leads to misrepresentation There is also a tendency to exaggerate the size of houses, &c, in the distance. This has the result of making these appear nearer than they are

89. Having considered the above difficulties, the sketch can now be commenced First draw in the outline of the skyline lightly with the aid of the points already fixed. Then draw in as accurately as possible the other principal objects, the position of which has been marked. Now the picture will be divided into sections by these objects In finishing the picture, each of these sections should be taken in detail and all that there is to be seen in it of military value should be drawn in, and thus the picture is completed, section by section.

The preliminary work of a landscape sketch should be drawn with a very light hand, and the smoother the paper the better.

In finishing the drawing, it is best to commence with the background, and work, gradually thickening the strokes, towards the front, where the thickest and blackest strokes are used.

It is of great assistance to clearness to show water, roads, &c., in conventional colours by means of chalks.

The last thing to do is to insert the information, viz, the point, referring to a map if there is one, from which the sketch is drawn, and the direction in which the centre of the picture is situated, the names of places and the ranges to them, &c

The date and state of the weather should be included, a panoramic sketch is much affected by atmospheric conditions

For these and other details, *see* Plate 18 Plate 19 shows a sketch prepared on squared paper for use in an artillery position, Plate 19A being the corresponding range-taker's card

Plate 20 shows a sketch actually executed during the Chitral Expedition, 1895 This, although a very useful sketch, omits some points which it would have been desirable to insert, *e g*, the compass direction

Plate 21 shows a sketch executed by one of the British officers attached to the Japanese Army in Manchuria to illustrate his report on the Battle of Liao Yang

The sketches represented in these Plates show in some casss more shading, &c, than is either generally necessary or possible *under service conditions, the process of printing having considerably* elaborated the originals

90. Finally, the telescopic sketch, as it might be called, may be considered This is a sketch which is made by the help of a telescope or good field glasses, of a distant piece of country, of which the details cannot be clearly seen by the naked eye At first this may seem difficult, but practice will soon overcome it First the subject should be looked at carefully with the naked eye, and an outline enlargement of it should be made on the paper Then

telescope the sketcher can look at once on the paper and draw in what he sees

CHAPTER XVI.

Elementary Instruction in Marching by the Stars.

91. Night marching under the best conditions is an operation demanding the greatest care and practice on the part of the guide The method of night marching by means of the Service Prismatic Compass has been described in Chapter VII

The most favourable conditions for a night march are a clear starlight night and no moon.

The guide first ascertains the magnetic bearing on which he intends to march during the night

He next selects a star, which has the required bearing. The methods that can be employed in the selection of the star are as follows:—

The black direction mark on the glass face of the service compass is turned till it coincides with the required bearing shown on the external ring. When the black arrow head is made to correspond with black direction mark, the line between the luminous patches on the lid indicates the line of advance.

[illegible]

take a fresh observation.

92. The most convenient stars to select for marching on are those which happen at the time to have an altitude of from 15° to 30°; stars below 15° may become lost in haze, whilst for those above 30° the head has to be inconveniently raised Speaking broadly, a star at these altitudes will rarely move more than 5° in azimuth (*i e*, to a flank) in 20 minutes. Hence if at the end of every 15 or 20 minutes the observer halts and takes a fresh bearing, he can count on keeping direction correctly.

Although it is of assistance to an observer to know the stars, it is not *necessary* that he should do so. Anyone can, with care, march on a compass bearing, with the stars as points to direct him, with satisfactory results, although he may be totally ignorant of the

names of the stars or even of the constellations. The great point is to be sure that the compass bearing is correctly taken and prolonged, and that the star selected is adhered to until a change is required.

Appendix I

FOREIGN MEASURES

Metric System—

Used in

[illegible]

land, Turkey, United States (partially), Venezuela

MEASURES OF LENGTH

—	Inches.	Yards
Millimetre	039	001
Centimetre	394	011
Decimetre	3·937	109
Metre	39·37	1 094
Kilometre	39370 79	1093 633

SQUARE MEASURES

—	Sq. yards	Acres.
Centiare (square metre)	1 196	—
Are (100 square metres)	119 603	025
Hectare	11960 333	2 471

OTHER FOREIGN MEASURES.

Country	Measure	Value
Russia	Sajen	= 7 feet.
	Verst (500 Sajen)	= 1,166 6 yds.
	Sq Verst	= 44 of a sq. mile.
	Desyatina	= 2·7 acres.
Denmark	Mil (2,400 Rode)	= 4 68 miles
Persia	Farsakh	= 3 87 miles (about).
	Zar (16 Gercho)	= 40 95 in.
Egypt	Kadam	= 1 foot.
	Diraa or Pik	= 22 83 in
	Kassaba	= 11 6 feet.
	Feddan	= 1 04 acres
China	Ts'un	= 1·41 in.
	Ch'ih (10 Ts'un)	= 14·1 in
	Chang (10 Ch'ih)	= 141 in.
	Li	= ⅓ mile (about).
Japan	Ri (36 Cho)	= 2 44 miles
	Cho (60 Ken)	= 119 3 yds
	Ken (6 Shaku)	= 1 988 yds.
	Shaku	= 11 93 ins
	Square ri	= 5·955 sq miles
	" cho	= 2 45 acres
	Tsubo	= 3 95 sq yds.
India	Ungul	= ·75 in.
	Hath	= 18 in.
	Gaz	= 1 yd.
	Kos	= 2,000 yds.
	Bigah	= 1,600 sq. yds.
United States	Same measures used as in England.	

APPENDIX II.

THE ANEROID BAROMETER.

Aneroid Barometers.—For military work a 2¼-inch barometer reading to 6,000 feet is a useful pattern.

In settled weather the aneroid barometer is often useful in sketching, especially on small scales where the contour intervals

are large. For instance, in sketching on a scale of 1 inch to 1 mile, where the intervals will be 50 feet, or on the $\frac{1}{2}$-inch scale with intervals of 100 feet, the aneroid will be found most useful. The aneroid should not be used in unsettled weather when the atmospheric pressure is varying

An aneroid used for field sketching should be provided with a movable scale of heights in feet If starting from a point of which the height is known, the scale should be set to that height before beginning work, or else a plausible height should be assumed, the reading should also be taken on returning If there is a difference, the intermediate altitudes should be corrected in proportion to the time which has elapsed.

An aneroid should always be read in the same position, either always held vertically on a level with the eye, or always horizontally, the latter is better Severe tapping is not good for an aneroid barometer

In changeable weather barometers are, of course, quite unreliable.

Diurnal variation of the barometer. This variation, which is [illegible] time of year On account [illegible] to arrange for checks on [illegible] able, however, in field [illegible]

APPENDIX III.

FINISHING UP SKETCHES FOR TACTICAL SCHEMES.

1. Sketches should be finished up with clearness and decision

"Can I read this in a poor light?"

"Can the eye rapidly pick up any special information likely to be wanted?"

"Is information given so definitely that a draughtsman could trace it without hesitation as to what is intended?"—are types of useful reflection

2. Written information takes the form of :—

(a) Reports.

(b) Marginal notes

Instructions for writing reports have been given in Chapter XII.

Short statements about particular features of the ground are better given in margins with a reference number, thus —(3) on the feature in question and in the margin opposite it. They must not obscure the sketch

3 In making a statement, distinguish between facts known to yourself and alleged facts based on information received, *e g*, a marginal note about a river "Fordable for infantry at (7)," would be wrong if not ascertained personally, and should be "Farmer Schmidt of (4) states fordable at (7)"

4. It is important that points on the sketch, such as cross roads and underfeatures, farms, &c, of tactical importance, should have a designation on the sketch. It may be necessary to refer to them in reports, orders, &c If such have no ascertainable name, or if there is doubt about it, a good expedient is to supply them with a letter, thus —(M).

[illegible]

if

1-

or

two Hill Barns 2½ miles apart on the Ordnance Survey 1-inch map of Worthing

6 The heading, printing, notes, and heights should be entered so that they can be read easily when the sketch is held so that the ground can be examined when looking towards the enemy.

Enlargements will usually be made with the N. at the top, and the direction of printing, &c., may have to be adjusted to the new direction required

7. All sketches should contain —

(a) A scale about 6 inches long A statement as to the V.I. used.

(b) A North Point lettered "Magnetic." If the variation of the compass is known, plot the true North Point also.

(*c*) Clear signature of sketcher, with date.

(*d*) State of the weather.

(*e*) Heading stating the general purpose of the sketch. To obviate wrongful deductions being made by anyone using a copy for another purpose.

Appendix IV.

MUTUAL VISIBILITY OF POINTS.

Two quick methods of determining whether any point B is visible from any other point A are given below —

[illegible]

Suppose there be [illegible]
suppose the height [illegible]
off on the plan the [illegible]
suppose AD = 1,200 [illegible]

Slope AD = a drop of 40 feet in 1,200 yards

$$= \frac{40}{1,200 \times 3} = \frac{1}{90}.$$

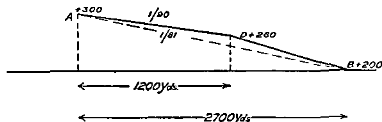
Slope AB = a drop of 100 feet in 2,700 yards

$$= \frac{100}{2,700 \times 3} = \frac{1}{81}$$

That is, the slope AB is steeper than AD; therefore, the point D will obstruct the line of sight AB.

Suppose D has been found to be below the line of sight AB, but hat there were several others points E, F, &c, which might obstruct

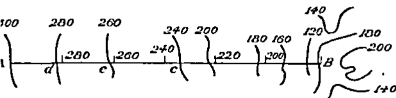
FIG. 21



the line of sight, each could be tested in turn. In this case it might be quicker to proceed by the second method.

This latter is best shown by an example.—

FIG. 22



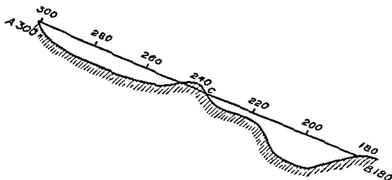
The above plan represents a portion of a map contoured at 20′ vertical interval. The line AB represents the line of sight: divide AB into a number of equal parts corresponding to the number of

the ground similarly at *e*.

But at c, where the 240 feet contour crosses the line of sight, the height of the latter is 237 feet (about), hence the ground is

higher than the line of sight at and close to this point. Now, as this line of sight is an even slope from A to B, therefore the visible.
is unnecessary

FIG. 23.



In the example given, A and B have each been assumed to be on

according to the V.I of the map contours), and then to compare the heights of the various points on the line of sight with those on the ground.

APPENDIX V

NOTES ON THE MAPS ISSUED BY THE GEOGRAPHICAL SECTION OF THE GENERAL STAFF FOR THE USE OF THE BRITISH EXPEDITIONARY FORCE ON THE CONTINENT.

The principal maps issued to the Expeditionary Force on the Continent are as follows :—

(1) Large scale or tactical maps —

France —$\frac{1}{80000}$, or about $1\frac{1}{4}$ miles to 1 inch.
Belgium —$\frac{1}{100000}$, or 1·58 miles to 1 inch.
Germany.—$\frac{1}{100000}$, or 1·58 miles to 1 inch.

(2) A map on the $\frac{1}{250000}$ scale or 4 miles to 1 inch of all three countries

In addition to these maps there is a general map, commonly known as the strategical map, of Belgium and north-east France, but this is only issued to the Staffs of Corps and Divisions. Maps on larger scales are also issued, as required, of special areas

A description will now be given of the principal maps

(3) $\frac{1}{80000}$ map of France (Plate 11). This map has been reproduced from the original French map. The original is in black only, but on certain sheets (number 2 to 24 on the Index, Plate 25) contours at 20 metres interval have been added. These contours must only be considered as approximately correct. The shape of the ground is, however, well shown by hachures, which vary in strength according to the height and steepness of the ground.

It is important to appreciate the significance of the hachures. The clearness of the map has necessarily suffered in the photographic reproduction of the original engraved map, and the general appearance of a sheet will sometimes appear confused When a map is actually in use, however, the general appearance is not the important point. The few square miles of country which are actually

being traversed, or on which the operations affecting the individual using the map are being carried on, are all that matter. A careful examination of the map will usually reveal the nature of that country, and in all cases it is fully worth while to make such an examination.

The conventional signs and translations of the French terms used on the map are given in the reference at the foot of each map. They should be carefully studied This map is not divided into squares with reference numbers and letters in the margin

(4) $\frac{1}{100000}$ map of Belgium This map has been prepared by the Geographical Section of the General Staff. Details and names are black, water blue, contours brown, woods green, and the main roads are coloured red The shape of the ground is well shown by the contours, which are at 10 metre intervals, or about 33 feet Numerous heights are also given in red, and it is important to remember that these heights are also in metres The class of the roads is indicated by colour, and in most cases the information given is reliable The condition of roads, however, varies from time to time The state of the road depends on the weather, and the classification of the roads must not be taken for more than it is worth. It represents the best information available at the time the map was prepared

One special feature of this map is that it gives the populations of towns and villages, according to the latest information at the time the map was being drawn, which may be anything from 5 to 8 years ago Here, again, a careful study of the reference on each map is well worth while. The map has reference numbers and letters in the margin, which refer to the sections into which the map is divided by the lines of latitude and longitude drawn across it.

(5) The $\frac{1}{250000}$ map of North-west Europe, including Belgium and parts of France, Holland, and Germany, is in the same general style as the $\frac{1}{100000}$ map of Belgium, but the symbols used for railways are different. The map requires but little explanation Contours are at 50 metre, or about 164 feet interval, and heights are also given in metres The rivers and their names are boldly depicted, which makes it easy to read the map quickly.

[illegible] contours are not
[illegible] the shape of the
[illegible] tween two rivers,
and often there will be but one or two [illegible] here are none the

country is practically flat, and where there is even one the con
height or value will indicate the extent of the rise

Most of the area covered by these four sheets is very thi
inhabited Numerous scattered houses will be observed M
more have of course been omitted, but the endeavour has
throughout to indicate the general character of the country.

The Ardennes begin in the East of Sheet 4, and cont
throughout Sheet 5, and these areas have a different characte
the rest of the map They are thickly covered with forest, and
contours are here close enough together to show the shape of
ground

The map is divided into 2-inch squares, which can be refe
to by the letters and numbers in the margin The length of
sides of the square is 2 inches, or almost exactly 8 miles

(6) $\frac{1}{250000}$ map of France Maps of other areas have
hurriedly prepared by copying the French map on the $\frac{1}{200000}$
and reducing it to the $\frac{1}{250000}$ scale A large area of France
been prepared in this style and also two sheets to the East of
area covered by the N W Europe series. These maps require
little explanation, but it should be observed that the contours
at 40-metre intervals as on the map from which they were co
It wa
to pr
any

The sheets of N.W. Europe and of the French series
x on the s
ex that the
Europe and
sheets to the East A new sheet to be called 2A is in prepara
and lies immediately North of sheet 6.

(7) Maps of Germany are, or will be, available on the $\frac{1}{10}$
and $\frac{1}{250000}$ scales. A specimen of the German $\frac{1}{100000}$ is
in Plate 10. The $\frac{1}{250000}$ will resemble the sheets of N.W. Eu
except that the contours will be at 40-metre intervals.

(8) The Strategical map of Belgium and N.E France is prep
on the layer system, the shape of the ground being indicate
tints which vary in depth according to the height. It i
a scale of $\frac{1}{320000}$, or 6 miles to one inch, and is a very
general map.

N.

O.

P.

Q.

R.

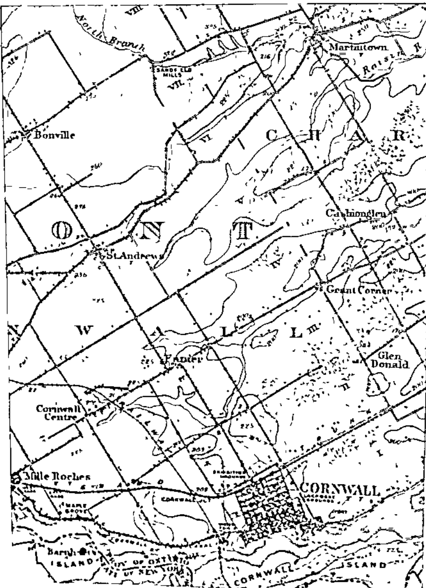
PAGE

S.

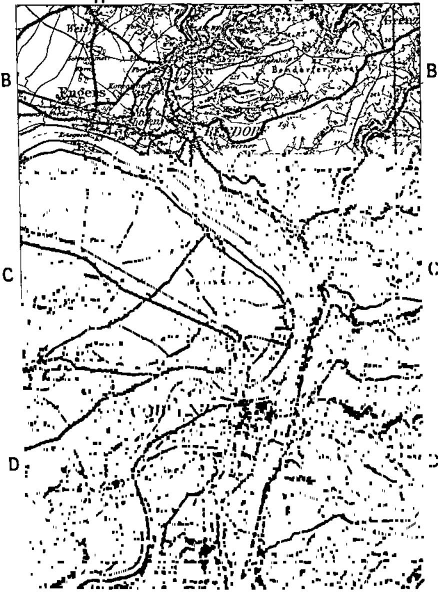
NOTE

Plates 5, 6, 7, 8, *and* 12, *of the* 1912 *Edition have not been included in this issue. Plates* 22, 23, 24, *and* 25 *have been added*

CANADA


North Branch
Martintown
Raisin R
SANDFIELD MILLS
Bonville
C H A R
Cashionglen
O N T
St Andrews
Grant Corner
W A L L
Glen Donald
Cornwall Centre
Mille Roches
CORNWALL
ISLAND
CORNWALL
ISLAND
Ordnance Survey Office Southampton
Scale $\frac{1}{126,720}$ or 1 Inch to 2
Miles
Miles

GERMANY.



Scale 1/120000 1.88 Miles to 1 inch

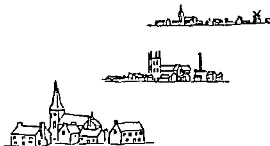
Mile 0 Miles

FRANCE



Scale 125 Miles to 1 inch

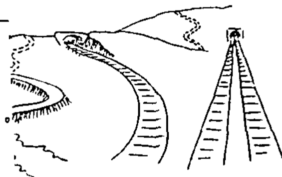




Villages



Roads & Railways



gs & Embankments